AIR FORCE
INSTALLATION RESTORATION PROGRAM

REMEDIAL INVESTIGATION FEASIBILITY STUDY
FOR
SHEPPARD AFB, TEXAS

TX3 571524161

REMEDIAL INVESTIGATION
FINAL WORK PLAN

X-Ref SA Vol #1

SUBMITTED TO
HEADQUARTERS AIR TRAINING COMMAND/DEEV
RANDOLPH AIR FORCE BASE, TX

SUBMITTED BY
HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE, TN 37831
GENERAL ORDER NUMBER 18B-97381C
TASK ORDER NUMBER X-09

PREPARED BY
NUS CORPORATION
OAK RIDGE, TN

SEPTEMBER 1988

D-34-7-8-1

SHEPPARD AIR FORCE BASE
FINAL WORK PLAN

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)
ELEVEN SITES

SHEPPARD AIR FORCE BASE
WICHITA FALLS, TEXAS

HAZWRAP SUPPORT CONTRACTOR OFFICE
OAK RIDGE, TENNESSEE
GENERAL ORDER NUMBER 18B-97381C
TASK ORDER X-09

NUS PROJECT NUMBER 4S39

SEPTEMBER 1988

SUBMITTED FOR NUS BY:

Douglas Hodson

DOUGLAS W. HODSON
PROJECT MANAGER

APPROVED FOR SUBMISSION BY:

Greg Potter

GREG A. POTTER, P.E.
PROGRAM MANAGER

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EXECUTIVE SUMMARY

INTRODUCTION

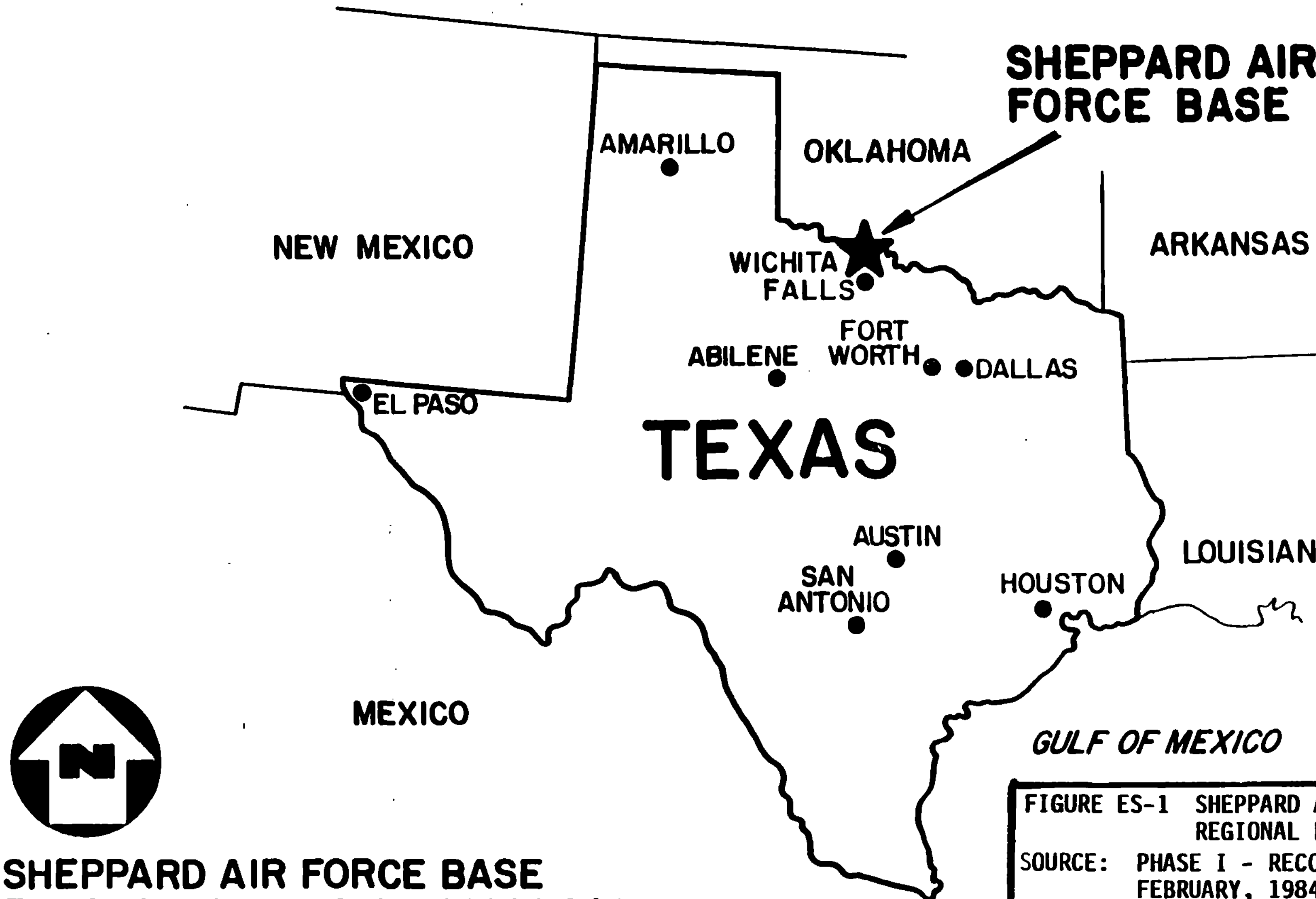
This Work Plan describes, in detail, a Remedial Investigation (RI) for 11 sites identified at Sheppard Air Force Base (AFB) in Wichita Falls, Texas.

The RI will provide data that will be used to: 1) either confirm or deny the presence of environmental contamination at the seven sites for which Phase II investigations have not been performed and 2) quantify the nature and extent of environmental contamination at the remaining four sites for which Phase II investigations have been performed. The results of the RI activities will be used to identify the following: which sites can be eliminated from further consideration; which sites, if any, will require additional investigation; and which sites, if any, require a Feasibility Study.

BACKGROUND INFORMATION

Sheppard Air Force Base (AFB) is located 4 miles north of Wichita Falls, Texas, which is in the north-central portion of the state and approximately 150 miles northwest of Dallas (see Figures ES-1 and ES-2). The base is bordered by agricultural lands on the north and east, limited residential and commercial development on the south, and a major highway with commercial development on the west. Bear Creek flows through the northern section of the base property. Sheppard AFB proper comprises 5,249 acres; in addition, 359 acres at two remote locations are affiliated with the base.

Topography at the base consists of gently rolling hills separated by large flat areas. Soils are generally poorly drained loams, comprised of silty and sandy clays derived from in-place weathering of the underlying bedrock. The bedrock at the base consists of Permian mudstone, sandstone, and siltstone which are exposed at several locations. There is no well-defined aquifer within the shaley Permian deposits. Depth to ground water varies widely, from less than 5 feet in the vicinity of the operational area and golf course to over 50 feet at Landfill 3.



SHEPPARD AIR FORCE BASE
REGIONAL LOCATION MAP
NOT TO SCALE

FIGURE ES-1 SHEPPARD AIR FORCE BASE REGIONAL LOCATION MAP

SOURCE: PHASE I - RECORDS SEARCH FEBRUARY, 1984

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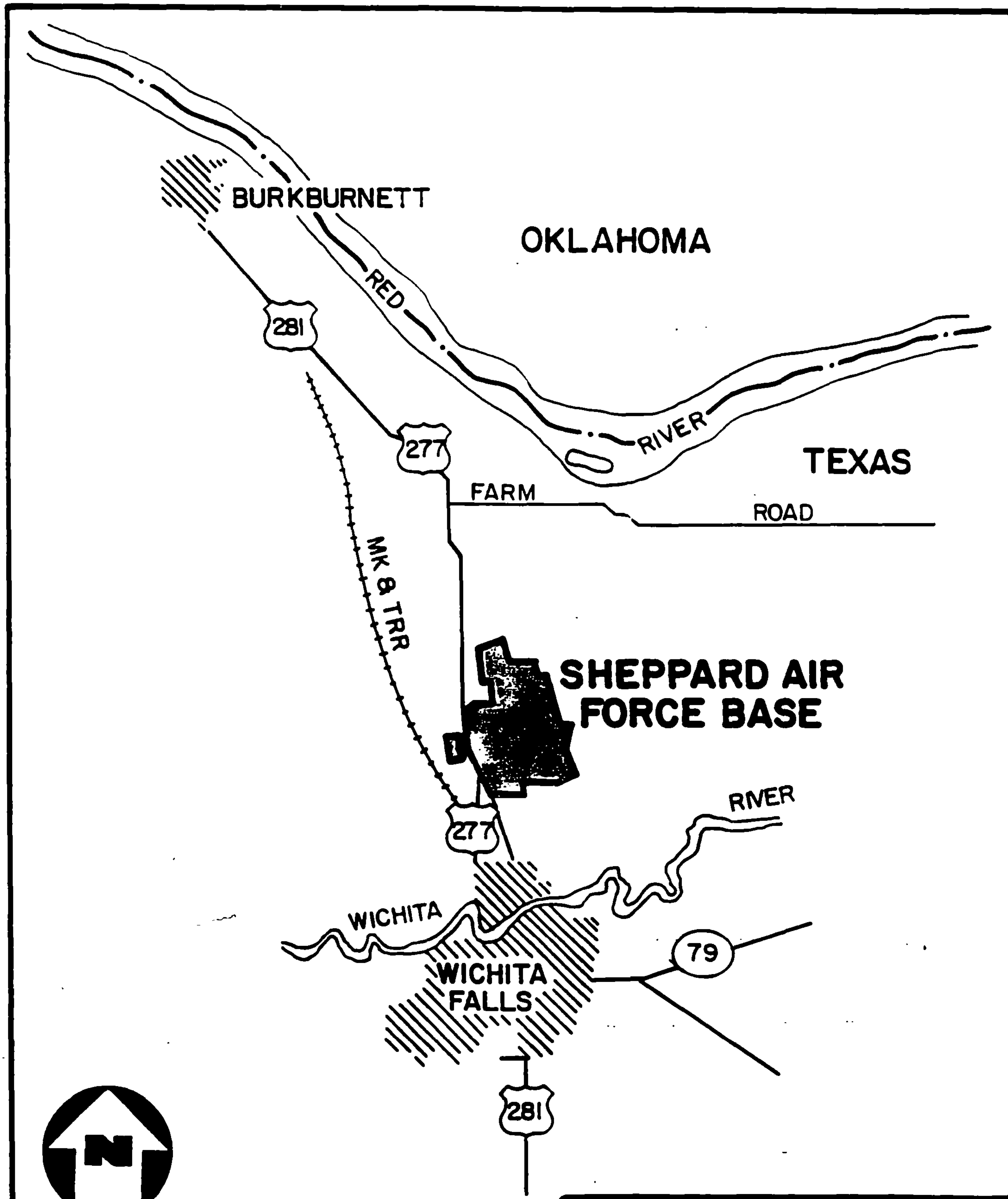

SHEPPARD AIR FORCE BASE

AREA LOCATION MAP

1" = 3 MILES

FIGURE ES-2 SHEPPARD AIR FORCE BASE
AREA LOCATION MAP
SOURCE: PHASE I - RECORDS SEARCH
FEBRUARY, 1984

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The RI will address 11 sites. These are listed below, with locations shown on Figure ES-3:

- Phase I Sites

  Landfill 1 (LF-1)
  Landfill 2 (LF-2)
  Fire Protection Training Area 2 (FPTA-2)
  Industrial Waste Pit (WP-2)
  Pesticide Spray Area (PSA)
  Low-Level Radioactive Waste Disposal Site (LLRW-1)
  Low-Level Radioactive Waste Disposal Site in Landfill 3 (LLRW-2)

- Phase II Sites

  Waste Pits (WP-1)
  Landfill 3 (LF-3)
  Fire Protection Training Area 1 (FPTA-1)
  Fire Protection Training Area 3 (FPTA-3)

SCOPE OF WORK

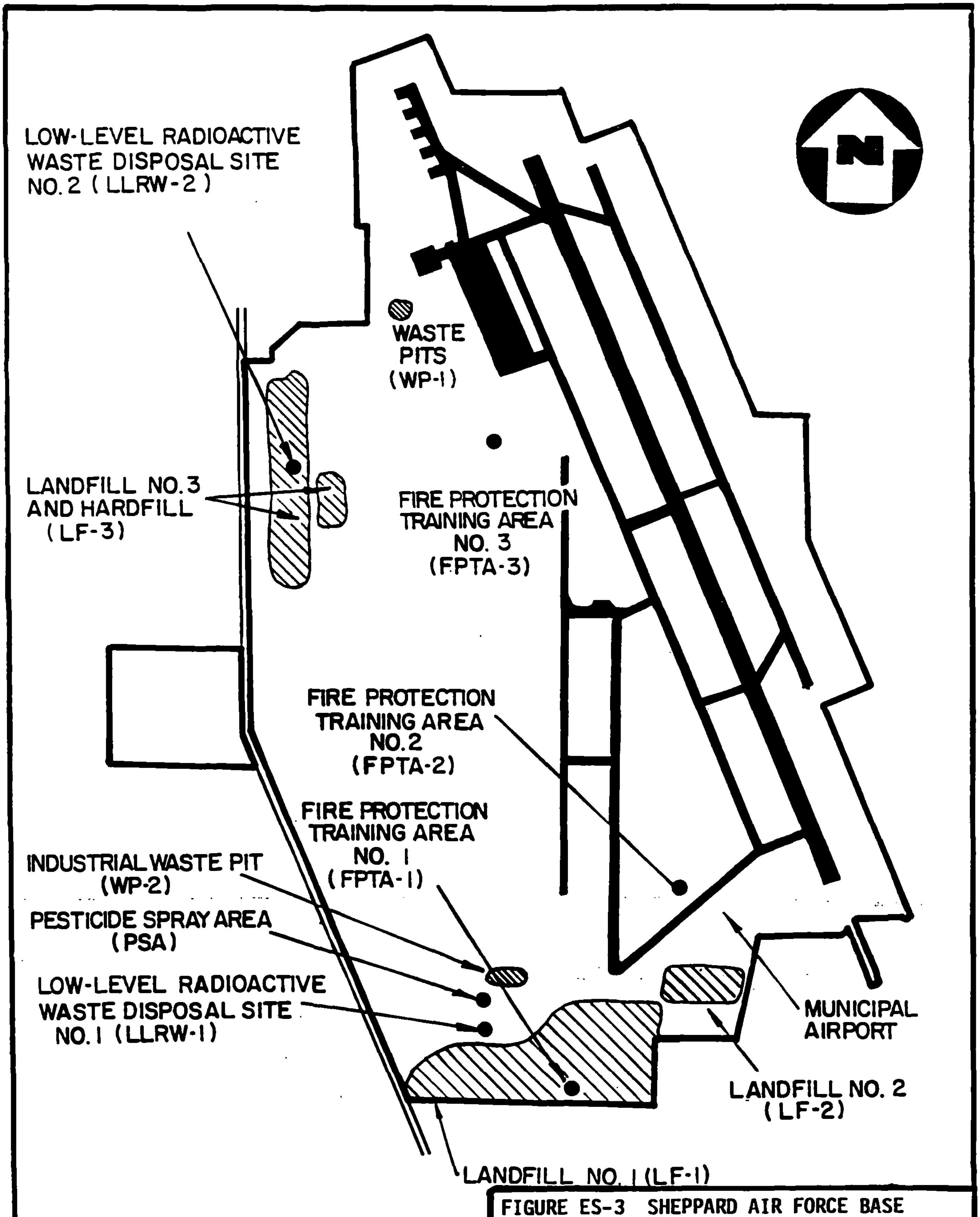
The RI can be subdivided into three major efforts: field activities; laboratory activities; and office activities. These are described below.

Field Activities

The primary field activities are as follows:

- Ground Surveying

  - The ground survey will accurately locate all borings, monitoring wells, sample points for soils/sediments, and points on the geophysical grid.



SHEPPARD AIR FORCE BASE
SITE PLAN
NOT TO SCALE

FIGURE ES-3 SHEPPARD AIR FORCE BASE SITE PLAN
SOURCE: PHASE I - RECORDS SEARCH FEBRUARY, 1984

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- Geophysical Investigation

  - Electromagnetic (EM) terrain conductivity and magnetometer surveying techniques will be utilized at the LLRW-2 site to locate the buried vault.

- Soil Organic Vapor (SOV) Survey

  - SOV survey techniques will be used at the FPTA-1, FPTA-3, and LF-1 sites to identify any contaminant plume migrating along the water table and allow for more efficient placement of borings/monitoring wells.

- Drilling Activities and Geologic/Hydrogeologic Investigation

  - A total of 13 soil borings will be installed initially with 20 additional borings proposed as optional (see Table ES-1) to determine the presence or absence of contamination; these will be completed as monitoring wells where ground water is encountered. Subsurface-soil sampling will also be performed. This investigation will characterize the subsurface pathways and the direction and rate of ground-water flow.

- Environmental Sampling

  - As shown in Tables ES-2 and ES-3, samples will be taken from various media (i.e., surface soils, surface water, ground water, and sediment) for field and laboratory analyses.

- Public Health and Environmental Assessment

  - An assessment will be performed to identify actual or potential threats, if any, to public health and/or the environment posed by the various sites.

TABLE ES-1

EXISTING AND PROPOSED BORINGS AND MONITORING WELLS SHEPPARD AFB

Site	Number of Borings/Wells			
	Existing	Proposed	Optional	Total
WP-1	--	--	3	3
LF-1	--	3	2	5
LF-2	--	2	2	4
LF-3	2	2	3	7
FPTA-1	4	3	--	7
FPTA-2	--	1	2	3
FPTA-3	3	1	3	7
WP-2	--	--	2	2
PSA	--	--	--	--
LLRW-1	--	--	1	1
LLRW-2	--	--	1	1
Base Background	--	1	1	2
Total	9	13	20	42

TABLE ES-2

NUMBER OF SAMPLES FOR LABORATORY ANALYSIS (BY SITE AND MATRIX) SHEPPARD AFB

Site	Soil			Water	
	Surface[a]	Subsurface	Sediment	Ground	Surface
WP-1	--	--	--	--	--
LF-1	1	3	1	3	1
LF-2	3	2	--	2	--
LF-3	2	6[b]	2	4[c]	2
FPTA-1	--	9[b]	--	7[c]	--
FPTA-2	4	1	--	1	--
FPTA-3	--	3[b]	--	4[c]	--
WP-2	--	--	--	--	--
PSA	4	--	--	--	--
LLRW-1	--	--	--	--	--
LLRW-2	--	--	--	--	--
Base Background	1	2	--	1	--
Total	15	26	3	22	3

Notes:

a "Surface" soil is defined as soil obtained at a depth of 0-3' below grade.
b Three subsurface soils will be analyzed from each boring at the three "Phase II" sites (Radian, 1987).
c Ground-water samples will be taken from all existing monitoring wells.

TABLE ES-3

NUMBER OF OPTIONAL SAMPLES FOR LABORATORY ANALYSIS (BY SITE AND MATRIX) SHEPPARD AFB

Site	Soil			Water	
	Surface[a]	Subsurface	Sediment	Ground	Surface
WP-1	1	9	1	3	1
LF-1	1	6	--	2	--
LF-2	--	6	--	2	--
LF-3	2	9	--	3	--
FPTA-1	--	--	--	--	--
FPTA-2	--	4	--	2	--
FPTA-3	--	6	--	3	--
WP-2	2	2	--	2	--
PSA	2	--	--	--	--
LLRW-1	--	1	--	1	--
LLRW-2	--	1	--	1	--
Base Background	--	2	--	1	--
Total	8	46	1	20	1

a "Surface" soil is defined as soil obtained at a depth of 0-3' below grade.

Laboratory Activities

This category includes the following:

- Receive field samples
- Analyze field samples
- Perform data validation, reduction, and evaluation
- Report analytical results

A summary of sample quantities and analytes, by site, is presented in Tables ES-4 and ES-5. A summary of QA sample quantities and analytes is presented in Tables ES-6 and ES-7.

Office Activities

This category includes the following:

- Project Management - Provides for the functions involved in directing and controlling the overall RI activities.

- Subcontract Coordination - Encompasses all in-office work required to select and to manage the efforts of the surveying and drilling subcontractors.

- RI Report Preparation - Upon completion of the RI activities, a report will be prepared that summarizes all results and recommends further action.

TABLE ES-4

ANALYTICAL PROGRAM FOR SHEPPARD AFB: WATER

Site/Parameter	LF-1	LF-2	LF-3	FPTA-1	FPTA-2	FPTA-3	Base	Total
TCL Volatile Organics	4	2	6	7	1	4	1	25
13 Priority Pollutant Metals	4	2	6	7	1	4	1	25
Priority Pollutant BN/A Extractables	4	2	6	7	1	4	1	25
PCBs (TCL)	4	2	6	7	1	4	1	25
Total Dissolved Solids (TDS)	2	2	4	7	--	--	1	16
Chloride	2	2	6	7	--	--	1	18
Fluoride	2	2	6	7	--	--	1	18
Bromide	2	2	6	7	--	--	1	18
Nitrate	2	2	6	7	--	--	1	18
Phosphate	2	2	6	7	--	--	1	18
Sulfate	2	2	6	7	--	--	1	18
Cyanide	2	2	6	--	--	--	1	11

Note: Table provides number of environmental samples (i.e., does not include QA samples or optional work). No water samples will be taken at the PSA site and the analytical programs for WP-1, WP-2, LLRW-1, and LLRW-2 are currently proposed as optional.

TABLE ES-5

ANALYTICAL PROGRAM FOR SHEPPARD AFB: SOIL/SEDIMENT

Site/Parameter	LF-1	LF-2	LF-3	FPTA-1	FPTA-2	FPTA-3	PSA	Base	Total
TCL Volatile Organics	5	5	10	9	5	3	--	3	40
13 Priority Pollutant Metals	5	5	10	9	5	3	--	3	40
Priority Pollutant BN/A Extractables	5	5	10	9	5	3	--	3	40
PCBs (TCL)	5	5	10	9	5	3	--	3	40
Cation Exchange Capacity	1	1	1	1	1	1	--	1	7
Organophosphorus Pesticides	--	--	--	--	--	--	4	1	5
Chlorinated Herbicides	--	--	--	--	--	--	4	1	5
Gamma Spectrometry	--	--	--	--	--	--	--	--	--
Pesticides (TCL)	--	--	--	--	--	--	4	1	5

Note: Table provides number of environmental samples (i.e., does not include QA samples or optional work). The analytical programs for WP-1, WP-2, LLRW-1, and LLRW-2 are currently proposed as optional.

TABLE ES-6

SUMMARY OF LABORATORY ANALYTES: WATER[a]
SHEPPARD AFB

Parameter	Total Number of Environmental Samples	Trip Blanks (Estimates)	Field Blanks (Estimates)	Rinsate Blanks (Estimates)	Field Duplicates (1/10)	Laboratory Duplicates (1/20)	Laboratory Spikes (1/10-Pesticide/PCB; 1/20-all)	Total
TCL Volatile Organics	25	13	4	6	3	1	1	53
13 Priority Pollutant Metals	25	--	4	6	3	1	1	40
Priority Pollutant BN/A Extractables	25	--	4	6	3	1	1	40
PCBs (TCL)	25	--	4	6	3	1	2	41
Total Dissolved Solids (TDS)	16	--	--	--	--	1	--	17
Chloride	18	--	4	6	3	1	--	32
Fluoride	18	--	4	6	3	1	--	32
Bromide	18	--	4	6	3	1	--	32
Nitrate	18	--	4	6	3	1	--	32
Phosphate	18	--	4	6	3	1	--	32
Sulfate	18	--	4	6	3	1	--	32
Cyanide	11	--	4	6	3	1	--	25

a Table does include optional samples.

TABLE ES-7

SUMMARY OF LABORATORY ANALYTES: SOIL/SEDIMENT[a]
SHEPPARD AFB

Parameter	Total Number of Environmental Samples	Trip Blanks (Estimates)	Field Blanks (Estimates)	Rinsate Blanks (Estimates)	Field Duplicates (1/10)	Laboratory Duplicates (1/20)	Laboratory Spikes (1/10 Pesticides/PCBs; 1/20 all)	Total
TCL Volatile Organics	40	30	--	15	4	2	2	93
13 Priority Pollutant Metals	40	--	--	15	4	2	2	63
Priority Pollutant BN/A Extractables	40	--	--	15	4	2	2	63
PCBs (TCL)	40	--	--	15	4	2	4	65
Cation Exchange Capacity	7	--	--	--	1	1	--	9
Pesticides (TCL)	5	--	--	2	1	1	1	10
Organophosphorus Pesticides	5	--	--	2	1	1	1	10
Chlorinated Herbicides	5	--	--	2	1	1	1	10

a Table does not include optional samples.

1.0 INTRODUCTION

This document is the Work Plan (WP) for the Remedial Investigation (RI) portion of the Installation Restoration Program (IRP) at Sheppard Air Force Base (AFB). The WP will serve as a guidance document for the field investigation and sampling activities, as well as subsequent laboratory analyses and preliminary risk assessment.

The WP is divided into text and appendices. The text describes the various elements of the project and, in particular, the proposed investigative program. Section 1.0 provides a summary of the WP contents and describes the project management organization and key project staff. Section 2.0 is a brief summary of background information from available reports and review of related published materials. Section 3.0 of the text provides a description of the tasks necessary to perform the RI, and includes the technical rationale used for selection of the various site-specific activities. Section 4.0 describes, in detail, the RI activities by site. Section 5.0 provides a schedule for performance of the RI.

The appendices include the following:

- Appendix A: Health and Safety Plan
- Appendix B: Quality Assurance/Quality Control Plan
- Appendix C: Technical Specification for Surveying Services
- Appendix D: Technical Specification for Drilling Activities
- Appendix E: Data Validation Guidelines

The WP text and each appendix are provided with separate tables of contents for easy reference.

1.1 AUTHORITY

This WP has been prepared in accordance with NUS' technical and cost proposals P8802115R1 dated March 23, 1988, and March 24, 1988, respectively. The proposals were prepared in response to request for proposal from Martin Marietta Energy Systems, Inc. (HAZWRAP) dated January 29, 1988.

1.2 PURPOSE

The IRP provides for field investigations, the preparation of Remedial Action Plans, and the remediation of hazards, where appropriate. The scope of the work described in this document outlines the RI which is conducted subsequent to either the Phase I Records Search or the Phase II Confirmation Study, depending on the particular site (see Section 1.4). The RI involves sampling, analysis, and all associated field work necessary to evaluate the sites. In addition, a preliminary risk assessment will be conducted to assess the actual and potential public health and/or environmental impacts of each site.

The inherent nature of hazardous waste site investigations demands taking advantage of available data in order to develop a comprehensive understanding of the sites being studied. Furthermore, the desire to secure the maximum value for the necessary expenditures requires that field investigations proceed in a deliberate and well-planned manner. The avoidance of unnecessary expenditures of time, effort, and money to better serve the broad goals of the IRP is best accomplished by conducting a field investigation in increments or stages. Hence, each successive stage can proceed with a sharper focus as a result of the more complete data base provided by the preceding stage. With that view in mind, this document is confined to presenting a plan for RI field investigations. The RI scope includes field activities (including sample collection), laboratory analysis of field samples, laboratory analytical data validation, and the preparation of a report on RI activities.

1.3 AVAILABLE DATA AND PREVIOUS STUDIES

The present WP was preceded by two earlier IRP documents, both of which specifically address the sites at Sheppard AFB:

1) Engineering-Science, Installation Restoration Program Phase I--Records Search, Sheppard AFB, Texas, February 1984.

2) Radian Corporation, Installation Restoration Program Phase II--Confirmation/Quantification, Stage I--Final Report, Volumes I and II, April 1987.

Document Number 1 is commonly referred to as the "Phase I Report." The authors conducted interviews, performed file searches and field surveys, and evaluated the sites using the Hazard Assessment Rating Methodology (HARM). The Phase I Report presents information regarding the regional and local environment, the status of identified sites, the past use of the sites, and the relative hazards posed by each site. Table 1-1 lists each site, along with the corresponding acronym and operation period.

Document Number 2, commonly referred to as the "Phase II Report," contains the results of field investigations conducted between October 1984 and February 1985. These investigations involved four of the waste sites (i.e., Waste Pits 1, Landfill 3, and Fire Protection Training Areas 1 and 3), and included geophysical surveys, the installation and sampling of nine ground-water monitoring wells, coring and sampling of shallow soils at Sites WP-1 and FPTA-1, and surface-water sampling from seven locations near the waste sites.

Documents 3 through 10 have also been used to prepare this WP; they are, hereinafter, referred to by the quoted name after each document name:

3) Baker, E. T., Jr., et al., 1963. Reconnaissance Investigation of the Ground-Water Resources of the Red River, Sulphur River, and Cypress Creek Basins, Texas. Texas Water Commission Bulletin 6306, Austin, Texas. "Baker, 1963"

4) Barnes, V. E., 1987. Geological Atlas of Texas Wichita-Lewton Sheet Bureau of Economic Geology, Austin, Texas. "Barnes, 1987"

5) Brown, L. F., Jr., 1969. Geometry and Distribution of Fluvial and Deltaic Sandstones (Pennsylvanian and Permian) North-Central Texas. Bureau of Economic Geology Geological Circular 69-4, Austin, Texas. "Brown, 1969"

6) Sheppard AFB, Texas Geological Investigation, 1988, United States Department of the Interior Geological Survey Water Resources Division, Austin, Texas. "USGS, 1988"

TABLE 1-1

SITES EVALUATED USING THE HAZARD ASSESSMENT RATING METHODOLOGY SHEPPARD AFB

Rank	Site	Operation Period
1	Waste Pits (WP-1)	1966-early 1970s
2	Landfill Number 3 (LF-3)	1957-1972
3	Fire Protection Training Area No. 3 (FPTA-3)	1957-Present
4	Fire Protection Training Area No. 1 (FPTA-1)	1941-1957
5	Fire Protection Training Area No. 2 (FPTA-2)	1962-1970
6	Industrial Waste Pit (WP-2)	1950s
7	Landfill No. 1 (LF-1)	1941-1957
8	Pesticide Spray Area (PSA)	1940s-Present
9	Low-Level Radioactive Waste Disposal Site in Landfill No. 3 (LLRW-2)	1960s-Present
10	Landfill No. 2 (LF-2)	Early 1960s
11	Low-Level Radioactive Waste Disposal Site (LLRW-1)	1960s-Present

7) National Oceanic and Atmospheric Administration, 1963. Rainfall Frequency Atlas of the United States, Technical Paper Number 40. National Climatic Center, Asheville, North Carolina. "NOAA, 1963"

8) National Oceanic and Atmospheric Administration, 1979. Climatic Atlas of the United States. National Climatic Center, Asheville, North Carolina. "NOAA, 1979"

9) Richardson, W. E., et al., 1977. Soil Survey of Wichita County, Texas. USDA, Soil Conservation Service, Iowa Park, Texas. "Richardson, 1977"

10) Stroman, W., 1983. U.S. Army Corps of Engineers, Civil Engineering, Geotechnical Branch, Fort Worth, Texas (817) 334-2150, October 25, 1983. "Stroman, 1983"

1.4 OBJECTIVES

The inherent nature of waste site investigations requires that field investigations proceed in a deliberate and well-planned manner. The current effort consists of a remedial investigation to

- Investigate the presence of environmental contamination at seven sites at Sheppard AFB (i.e., those sites addressed in the Phase I Report, but not addressed during the Phase II investigation).

- Quantify the nature and extent of environmental contamination at four sites at Sheppard AFB (i.e., those sites addressed in the Phase II Report).

The broad objectives of the RI field investigation are as follows:

- Perform a preliminary hydrogeologic evaluation.

- Acquire field data to investigate the presence or absence of environmental contamination.

- Identify the contaminants of concern and their concentrations, where the presence of environmental contamination is confirmed.

- Determine which sites, if any, require additional investigation.

The results of the RI activities will be used to determine which of the following recommendations is applicable:

- Take no further action; prepare a Decision Paper.
- Acquire additional data via a Stage II RI.
- Prepare plans for immediate removal; prepare a Decision Paper.
- Prepare a Feasibility Study

Individual site objectives and the field activities to be conducted at each site, in pursuit of these objectives, are described in Section 4.0.

1.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

One of the primary concerns in the development of remedial action alternatives for sites governed by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the degree of public health or environmental protection afforded by each remedy. EPA policy states that in the process of developing and selecting remedial action alternatives, primary consideration should be given to actions that attain or exceed Applicable or Relevant and Appropriate Requirements (ARARs), as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Superfund Amendments and Reauthorization Act (SARA). The purpose of these requirements is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements.

SARA defines an ARAR as

- Any standard, requirement, criteria, or limitation under federal environmental law.

- Any promulgated standard, requirements, criteria, or limitation under a state environmental or facility siting law that is more stringent than the associated federal standard, requirement, criteria, or limitation.

Applicable requirements are federal public health and environmental requirements that would be legally applicable to a remedial action, if that action was not undertaken pursuant to CERCLA. For example, if hazardous waste activities were undertaken pursuant to an approved permit, applicable regulations would be available to legally define the required remedial action for site closure.

Relevant and appropriate requirements are federal public health and environmental requirements that apply to circumstances sufficiently similar to those encountered at CERCLA sites, where their application would be appropriate although not legally required. In addition, SARA now requires that state ARARs be considered during the assembly of remedial alternatives if they are more stringent than federal requirements. EPA has also indicated that health-based criteria, advisories, and guidelines must be considered in devising remedial alternatives.

Tables 1-2 and 1-3 provide a preliminary listing of the Federal and State of Texas ARARs identified for the Sheppard Air Force Base sites. The ARARs identified will be refined and revised to consider site conditions and potential remedial actions as the RI/FS process develops. The ARARs will be evaluated in terms of their applicability, relevancy, and appropriateness to the site and will be grouped based on specific categories (i.e., action-specific, location-specific, and contaminant-specific). The ARARs will be considered at six decision points. These include:

- <u>Field Investigation</u> - ARARs must be considered when determining data to be collected during the field investigation.

- <u>Public Health Evaluation</u> - Consider ARARs during the analysis of risk to public health and the environment.

- <u>Development of Remedial Objectives</u> - Compare site data base to ARARs.

- <u>Identification of Applicable Technologies and Assembly of Alternatives</u> - Utilize ARARs specific to site conditions for development of action levels, specific response objectives, and remedial alternatives relative to criteria defined in 40 CFR 300.68(f). Also, identify ARARs that apply to the formulated alternatives.

TABLE 1-2

FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SHEPPARD AIR FORCE BASE
WICHITA FALLS, TEXAS

Requirement	Rationale
1. Hazardous Waste Requirements (RCRA Subtitle C, 40 CFR, Part 264)	Standards applicable to treating, storing, and disposing of hazardous waste.
2. Safe Drinking Water Act	
a. Maximum Contaminant Levels (MCLs)	Remedial actions may provide cleanup to the MCLs.
b. Maximum Contaminant Level Goals (MCLGs)	Considered in the public health assessment.
c. Underground Injection Control Regulations (40 CFR, Parts 144, 145, 146, and 147)	May be applicable to onsite ground-water recirculation systems.
3. Toxic Substances Control Act (15 U.S.C. 2601)	
a. PCB Requirements (40 CFR 761)	PCBs are possible site contaminants.
b. TSCA health data, chemical advisories, and Compliance Program policy	Considered in the public health evaluation.
4. Health Advisories, EPA Office of Drinking Water	Environmental sampling identified presence of chemical for which health advisories are listed.
5. Clean Water Act (PL92-500)	
a. Federal water quality criteria (FWQC)	Remedial actions may provide ground-water remediation and discharge to surface waters.
b. NPDES permit	Remedial alternatives may include discharge to surface waters.
6. Clean Air Act (42 USC 7401)	
a. National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (40 CFR Part 50)	Remedial alternatives may include incineration or ground-water volatilization technologies.
b. Public health basis to list pollutants as hazardous under Section 112 of the Clean Air Act	Remedial alternatives may include incineration or ground-water volatilization technologies.
7. OSHA Requirements (29 CFR, Parts 1910, 1926, and 1904)	Required for workers engaged in onsite remedial activities.

TABLE 1-2

FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SHEPPARD AIR FORCE BASE
WICHITA FALLS, TEXAS
PAGE TWO

Requirement	Rationale
8. DOT Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1-171.500)	Remedial alternatives include offsite treatment and disposal.
9. Pesticide Registration, Tolerances, and Action Levels	Pesticides are possible site contaminants.
10. Health Effects Assessments	Considered in the public health risk assessment included in RI report.
11. EPA's Groundwater Protection Strategy	Remedial alternatives must consider EPA classification of ground-water conditions at site.
12. EPA Regulations on Sole Source Aquifer 40 CFR 449.110	Edwards aquifer is considered a sole source aquifer.

TABLE 1-3

STATE OF TEXAS APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SHEPPARD AIR FORCE BASE
WICHITA FALLS, TEXAS

Requirement	Rationale
Texas Solid Waste Disposal Act, Public Article 4477-7	Applicable to hazardous wastes.
Texas Solid Waste Management Regulations, TAC, Title 25, Chapter 325	Standards applicable to hazardous waste.
Texas Industrial Waste Management Regulation, TAC, Title 31, Chapter 335	Standards applicable to hazardous waste.
Texas Water Quality Acts, TC, Water Code, Title 2	Remedial actions may include discharge to surface waters.
Texas Wastewater Treatment Regulations, TAC, Title 31, Part IX	Remedial actions may include discharge to surface waters.
Texas Consolidated Permit Rules, TAC, Title 31, Chapter 305	Remedial actions may require meeting the substantive requirements of permits.
Texas Water Quality Standards, TAC, Title 31, Chapters 307 and 333	Remedial actions may include discharge to surface waters.
Texas Clean Air Act, TCSA, Title 71, Article 447-5	Incineration or volatilization technologies are considered potential remedial actions.
Texas Regulation V: Control of Air Pollution From Volatile Organic Compounds, TAC, Title 31, Chapter 115	Incineration or volatilization technologies are considered potential remedial actions.
Texas Regulation VI: Control of Air Pollution by Permits for New Construction or Modification, TAC, Title 31, Chapter 166	Incineration or volatilization technologies are considered potential remedial actions.

- Screening of Remedial Technologies/Alternatives - Consider ARARs when assessing the effectiveness of an alternative, as defined in 40 CFR 300.68(g)(3).

- Remedial Alterantives Evaluation - Evaluate each alternative to the extent it attains or exceeds ARARs, as defined in 40 CFR 300.68(h)(2)(iv).

1.6 SCOPE OF WORK

1.6.1 Scope

The RI activities will provide data that can be used to evaluate contamination at 11 potential hazardous waste sites identified at Sheppard AFB. This phase of the IRP is basically a "risk-driven" phase and, as such, there are three general areas of concern

- Migration pathways
- Source identification
- Effects on receptors

The migration pathways will be identified using existing site-specific and regional information (HAZWRAP Report, U.S. Geological Survey reports, Department of Transportation and Development Office of Public Works, Water Resources Section, Public Health Agencies, etc.) and site-specific investigations. This information will identify subsurface, surface, and atmospheric contaminant migration pathways. Information pertaining to the following sciences will be compiled during the investigation:

- Geology
- Pedology (study of soils)
- Ground-Water Hydrogeology
- Surface Hydrology
- Meteorology

The regional information will help identify background soil, water, and air quality.

Source identification is accomplished in part by conducting a subsurface evaluation at the sites. In conjunction with the source identification, subsurface pathways are assessed. These areas of concern are addressed by a preliminary hydrogeologic evaluation designed to

- Assess the ground-water regime.
- Characterize the subsurface geology.
- Identify subsurface transport pathways.
- Provide baseline information for subsequent investigations or for remedial action(s), if necessary.

The receptor impacts and effects are accomplished by a preliminary risk assessment of the potential impacts of the conditions at each site. The preliminary risk assessment assesses the migration modes (ground-water flow, stream flow, concentration, deposition, etc.) in conjunction with the exposure modes (ingestion, inhalation, and dermal contact) in determining the risk posed to human health and the environment. It is anticipated that the preliminary risk assessment will indicate one of the following three possibilities:

- Site conditions represent no significant public health or environmental threat.

- Site conditions may represent a public health and/or environmental threat under limited circumstances.

- The impact represented by site conditions cannot be sufficiently determined, based on the available data and what additional data is needed.

1.6.2 Work Plan Tasks

In the following subsections, a brief description is provided for each of the tasks necessary to accomplish the work described in this work plan.

Task 01: Project Management

This task provides for the functions involved in directing and controlling the overall RI activities. Those functions include:

- Establishing, controlling, and tracking schedules and budgets.

- Performing project-specific coordination with, and status reporting to, HAZWRAP.

- Coordinating between field and office activities to maintain a link between technical and administrative requirements.

- Attending periodic internal meetings necessary to maintain the ongoing work within the context of evolving program requirements.

Task 02: Subcontract Coordination

This task provides for the in-office functions connected with:

- Defining scope, schedule, and other project-specific requirements (i.e., site access, staging areas, etc.)

- Monitoring the progress of work in comparison to the costs incurred.

- Reviewing and approving subcontractor invoices.

- Coordinating between field and office activities to maintain a link between technical and administrative requirements relative to subcontracted work.

Task 03: Mobilization/Demobilization

The efforts encompassed by this task include:

- Coordinating, assembling, preparing, and shipping equipment and supplies to and from the field.

- Coordinating support services (i.e., staging areas, utilities, lodging, transportation, etc.) to prepare for the planned activities on the installation and to arrange for personnel requirements.

- Coordinating with the various entities at Sheppard AFB (i.e., Security, Flight Operations, etc.) through the base Environmental Coordinator in connection with scheduling the work.

- Conducting mobilization and demobilization meetings with field personnel.

- Performing final clean up and storage of field equipment following field activities.

Task 04: Ground Surveying

This task encompasses:

- Establishing semipermanent surveying monuments.

- Performing surveys to establish the horizontal and vertical location of monitoring wells, borings, surface samples, soil organic vapor (SOV) probe locations, etc.

- Reducing field survey notes and preparing the data for more formal presentation.

- Providing a Site Plan for the area surveyed by the various geophysical techniques.

Task 05: Geophysical Investigations

This task will attempt to locate the radioactive burial vault at LLRW-2. Electromagnetic (EM) terrain conductivity and magnetometer surveying techniques will be used at LLRW-2. Data collected by these nondestructive geophysical techniques will be supplemented with field observations.

Task 06: Drilling Activities

This task includes:

- All drilling connected with soil borings and monitoring wells.
- Installation of monitoring wells and well development.
- Directing, monitoring, and coordinating drilling activities in the field.

Task 07: Geologic/Hydrogeologic Investigation

This task encompasses:

- Evaluation of the subsurface data derived from the drilling activities and reporting those findings.

- Application of SOV monitoring at certain sites.

- Collection, preservation, and shipping of all subsurface-soil samples.

Task 08: Health and Safety Oversight

This task includes:

- Coordinating and administering the health and safety monitoring aspects of field activities during the following tasks:

    - Task 03: Mobilization/Demobilization
    - Task 04: Ground Surveying
    - Task 05: Geophysical Investigation
    - Task 06: Drilling Activities
    - Task 07: Geologic/Hydrogeologic Investigation
    - Task 09: Environmental Sampling

- Coordinating with subcontractors regarding the health and safety requirements for the work and the documentation of subcontractor personnel physicals and training.

- Conducting on site project-specific training for subcontractor personnel and daily health and safety monitoring.

Task 09: Environmental Sampling

This task includes collection, preservation, and shipping of all surface-soil, sediment, ground-water, and surface-water samples.

Task 10: Laboratory Analyses

This task encompasses the in-laboratory functions necessary to receive field samples, analyze the field samples while adhering to prescribed QA/QC procedures, and report the results of those analyses.

Task 11: Laboratory Data Validation

This task provides for reviewing analytical data reported by the laboratory and determining the suitability of that data for use in subsequent, data-sensitive evaluations including the Risk Assessment.

Task 12: Public Health and Environmental Assessment

This task includes assessing the present and future public health and environmental risks associated with the chemical contaminants identified. Factors considered include:

- The nature and extent of contamination.
- Chemical migration potential.
- Potential for exposure.
- The resultant effects on human and environmental receptors should exposure occur.

The impact may vary depending upon the nature of the exposed receptor and exposure pathway (i.e., dermal, inhalation, ingestion) as well as the intensity and duration of exposure. This task will also address the issue of compliance with ARARs and regulations as related to environmental chemical contamination.

Task 13: Preparation of Remedial Investigation Report

The report on RI activities will develop baseline data to evaluate each site.

The Remedial Investigation Report (RIR) will be organized by site and the data gathered will be presented in a format acceptable to the regulatory community. The RIR will include the following:

- Executive Summary
- Introduction
  - Site Background Information
  - Nature and Extent of Problem(s)
  - Remedial Investigation Summary
  - Overview of Report
- Site Features Investigation
  - Demography
  - Land Use
  - Natural Resources
  - Climatology
- Hazardous Substances Investigation
  - Waste Types
  - Waste Component Characteristics and Behavior
- Hydrogeologic Investigation
  - Soils
  - Geology
  - Ground Water

- Surface Water Investigation
    - Surface Water
    - Sediments
    - Flood Potential
    - Drainage

- Bench and Pilot Test

- Public Health and Environmental Concerns
    - Potential Receptors
    - Public Health Impacts
    - Environmental Impacts

- Recommendations

The following information will be included as appendices:

- Geophysical tracings.

- Well-numbering system, boring, and well completion logs.

- Sampling and analytical procedures (including field and laboratory QA/QC plans utilized for this project). Summary of sampling methods used, detection levels, holding times, and chain-of-custody forms.

- Analytical data, including internal QC data laboratory blanks, laboratory spikes, and laboratory duplicates.

- References, if any.

1.7 PROJECT MANAGEMENT ORGANIZATION

The project organization for implementing the Sheppard AFB WP is illustrated in Figure 1-1. Key personnel business addresses and telephone numbers are included in Table 1-4. The responsibilities of key personnel are outlined below.

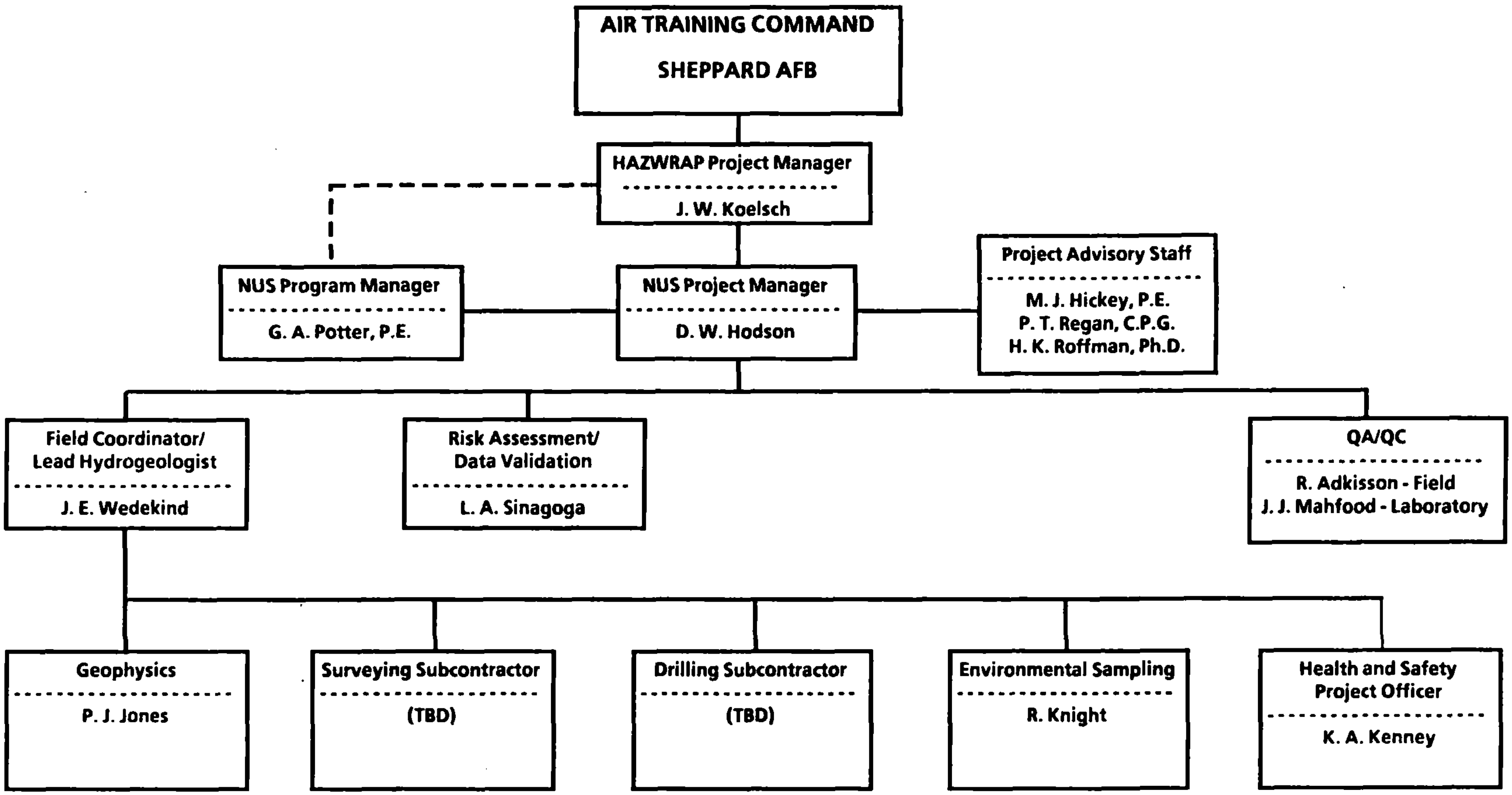

FIGURE 1-1
PROJECT MANAGEMENT ORGANIZATION
SHEPPARD AFB

TABLE 1-4

KEY PERSONNEL BUSINESS ADDRESSES
AND TELEPHONE NUMBERS
SHEPPARD AFB

Personnel	Addresses and Telephone Numbers
J. W. Koelsch	HAZWRAP Support Contractor Office P. O. Box 2009 Oak Ridge, Tennessee 37831 (615) 576-2014
G. A. Potter D. W. Hodson P. T. Regan J. E. Wedekind	NUS Corporation 800 Oak Ridge Turnpike Jackson Plaza C-200 Oak Ridge, Tennessee 37830 (615) 483-9900
H. K. Roffman K. A. Kenney L. A. Sinagoga P. J. Jones	NUS Corporation Park West Two Cliff Mine Road Pittsburgh, Pennsylvania 15275-1071 (412) 788-1080

Douglas W. Hodson

Mr. Hodson will serve as the NUS Project Manager for the Sheppard AFB RI. In this position, he will be responsible for the following: the overall technical quality of project activities and deliverables; adherence to schedule and budget; and communications with Energy Systems and Sheppard AFB personnel.

Mr. Hodson will also serve as Subcontract Coordinator. His chief duties will include the following: identification of subcontractors; development of special provisions; development of detailed statements of work; and the evaluation of bids and monitoring of work progress in comparison to the costs incurred.

Mr. Hodson will be able to call on the experience and advice of: Mr. Greg A. Potter, P.E., Program Manager; Mr. Peter T. Regan, Senior Hydrogeologist; Dr. Haia K. Roffman, Director of NUS' Chemistry/Toxicology Department; and Mr. Michael J. Hickey, P.E., Deputy Program Manager.

Greg A. Potter, P.E.

Mr. Potter functions as NUS' IRP Program Manager. As such, he will have primary responsibility for the RI activities. His responsibilities will include oversight/coordination intended to ensure that the performance of the RI investigation is consistent with broad program goals, while addressing project-specific needs.

James E. Wedekind

Mr. Wedekind will serve as the Field Coordinator for all onsite activities. His functions will include the following:

- Coordinating onsite activities with the Sheppard AFB Environmental Coordinator.

- Maintaining and adjusting the field activities schedule.

- Providing the NUS Project Manager with updates on the work and any difficulties encountered in the field.

Mr. Wedekind will also serve as the Lead Field Geologist. He will have responsibility for the following:

- Monitoring the drilling subcontractor's work.
- Ensuring the accuracy of the drilling logs.
- Directing sampling efforts during borings.
- Managing the geologic/hydrogeologic investigation.
- Monitoring the surveying subcontractor's work.

Haia K. Roffman, Ph.D.

As Director of Risk Assessment and Toxicology, Dr. Roffman's responsibilities include the validation of analytical laboratory data. In this capacity, she will ensure the timely and accurate review of data received from the laboratory to verify that the requested analytical protocols were, in fact, followed. In addition, Dr. Roffman will lead a staff of risk assessment personnel in assessing each site.

John J. Mahfood

Mr. Mahfood is the NUS Laboratory Group Account Executive for HAZWRAP. He will be a primary contact with regard to the chemical analyses to be performed on soil and water field samples. His overall responsibility within the Sheppard AFB investigation includes receiving and tracking samples through the analytical process, adhering to analytical protocols, and conveying the analytical results.

Kevin A. Kenney

Mr. Kenney will serve as the Project Health and Safety Officer (HSO). He will coordinate all health and safety activities for field personnel (including subcontractors) in accordance with the Health and Safety Plan (HASP) contained in Appendix A of this WP.

2

2.0 BACKGROUND INFORMATION

The discussion which follows was primarily derived from the Installation Restoration Program Phase I - Record Search. Additional information was derived from the Phase II report and other sources as cited in the text. The following sections provide a general discussion of the base environmental setting, history, and individual site descriptions.

2.1 BASE LOCATION AND DESCRIPTION

Sheppard Air Force Base (AFB) is located 4 miles north of Wichita Falls, Texas, which is in the north-central portion of the state and approximately 150 miles northwest of Dallas (see Figures 2-1 and 2-2). The base is bordered by agricultural lands on the north and east, a road with limited residential and commercial development on the south, and a major highway with commercial development on the west. Bear Creek flows through the northern section of the base property. Sheppard AFB proper comprises 5,249 acres; in addition, 359 acres at two remote locations are affiliated with the base.

2.2 BASE HISTORY

Plans for a training school in north central Texas were first approved by the Army Air Corps in early 1941, after procurement of a 300-acre site in 1940; Sheppard Field was activated in late 1941.

During World War II, basic training schools were conducted at Sheppard Field for glider mechanics, advanced pilot training, liaison aircraft training for ground officers, training for instructors, B-29 engineers, and C-82 transport mechanics (in addition to the aviation mechanics school).

The field was deactivated in August 1946 and was manned by a caretaker staff. In August 1948, the field was reactivated as Sheppard AFB. It has maintained active status since that date. Basic training was conducted at Sheppard AFB until June 1949. It was conducted again from 1950 until 1954. Phase II of basic military training was conducted periodically from 1956 until 1966.

SHEPPARD AIR FORCE BASE
REGIONAL LOCATION MAP
NOT TO SCALE

FIGURE 2-1 SHEPPARD AIR FORCE BASE REGIONAL LOCATION MAP
SOURCE: PHASE I - RECORDS SEARCH FEBRUARY, 1984

NUS CORPORATION

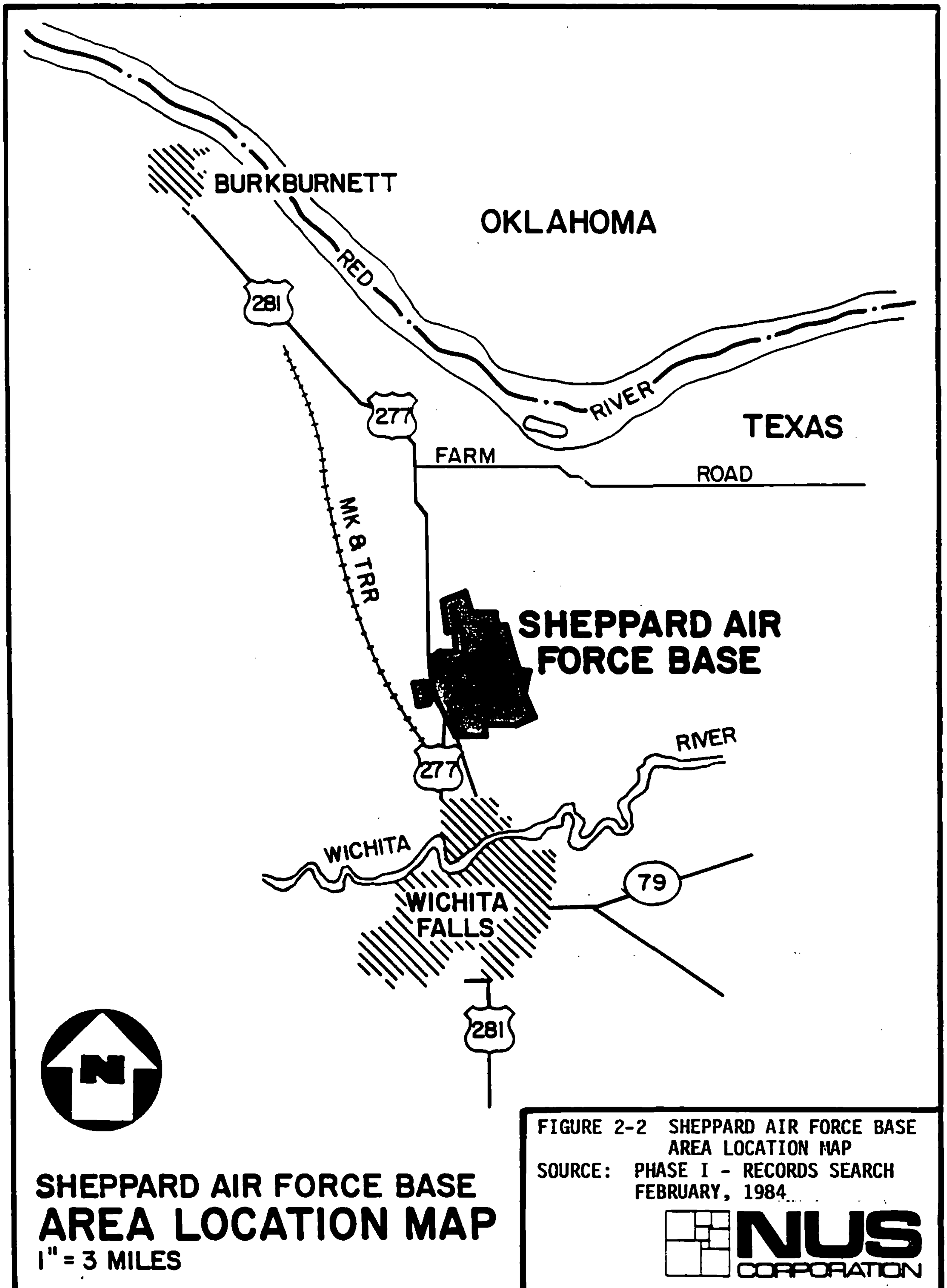

FIGURE 2-2 SHEPPARD AIR FORCE BASE AREA LOCATION MAP

SOURCE: PHASE I - RECORDS SEARCH FEBRUARY, 1984

NUS CORPORATION

Numerous training schools have been transferred to Sheppard AFB since its reactivation; these are as follows:

- In 1949, the Airplane and Engine Mechanics School was transferred to Sheppard from Keesler AFB. This school later became the Department of Aircraft Maintenance Training in the USAF School of Applied Aerospace Sciences (SAAS).

- In 1954, Comptroller and Transportation Training were transferred from Lowry AFB to Sheppard AFB.

- The Department of Missile and Space Training was established in 1956. In 1958, Sheppard AFB was designated the prime training center for the Atlas, Titan, Thor, and Jupiter ballistic missiles. In 1985, this training was phased out. At present, Sheppard AFB conducts no ballistic missile training.

- Communications training and Civil Engineering training were transferred to Sheppard AFB in 1958-59.

- In 1959, Sheppard AFB assumed a portion of Field Training from Chanute AFB.

During the 1960s, significant changes at Sheppard AFB included the activation of the 3637th Flying Training Squadron (Helicopter) in 1965 and the transfer of the Medical Services School from Gunter AFB in 1966. The 3637th Flying Training Squadron became part of what is now the 80th Flying Training Wing (FTW), which presently conducts training in T-37 and T-38 aircraft. The 3790 Medical Services Training Wing, previously called The Medical Service School, which is presently the School of Health Care Sciences (SHCS), conducts basic and advanced professional medical training, as well as the orientation of newly commissioned officers.

The major tenant organizations at Sheppard AFB are listed below:

- 80th Flying Training Wing (FTW)
- Air Force Audit Agency Office
- 2054th Communications Squadron
- 3314th Management Engineering Squadron, Detachment 5

- 24th Weather Squadron, Detachment 12
- Federal Aviation Administration (FAA) Representative
- Headquarters, Air Force Commissary Service

2.3 SITE DESCRIPTIONS

The locations and approximate sizes of all sites are shown in Figure 2-3. The following site descriptions are based on both the Phase I and II Reports and field observations.

2.3.1 Waste Pits (WP-1)

In 1966, three waste pits were excavated to contain waste engine cleaning fluids and solvents from nearby maintenance buildings. These pits were along Avenue H, across from Building 2325 (see Figure 4-1), and within the floodplain of Bear Creek. The pits were approximately 80 feet square, 10 feet deep, and unlined (Phase II report). On one occasion in the late 1960s, an adjacent storm pond overflowed and carried some of the waste pit contents into the storm water system and, hence, into Plum Creek. The pits were actively used from 1966 to the mid-1970s. The boundaries of WP-1 are undefined, since the pits were "scraped away" when they had outlived their usefulness.

The Waste Pits were subject to a Phase II - Confirmation/Quantification Study (Phase II report). In this study, no groundwater was encountered to a depth of 45 feet in the clayey soils; however, oil and grease contamination was found at depths from 17.5 to 30 feet. A geophysical survey conducted as a part of this study failed to discern the boundaries of the original pits or any contaminant plume(s).

2.3.2 Landfill 1 (LF-1)

Landfill 1 was operated from 1941 until about 1957, when it was completely closed and graded for construction of the base golf course. Some portions of the landfill, namely those on the west side of the fill, were closed about 1952 and base housing was subsequently constructed on the area. Precise dimensions of the total area used as landfill are uncertain, but aerial photographs and interviews with base personnel indicate the approximate boundaries shown in Figure 4-2; placement of

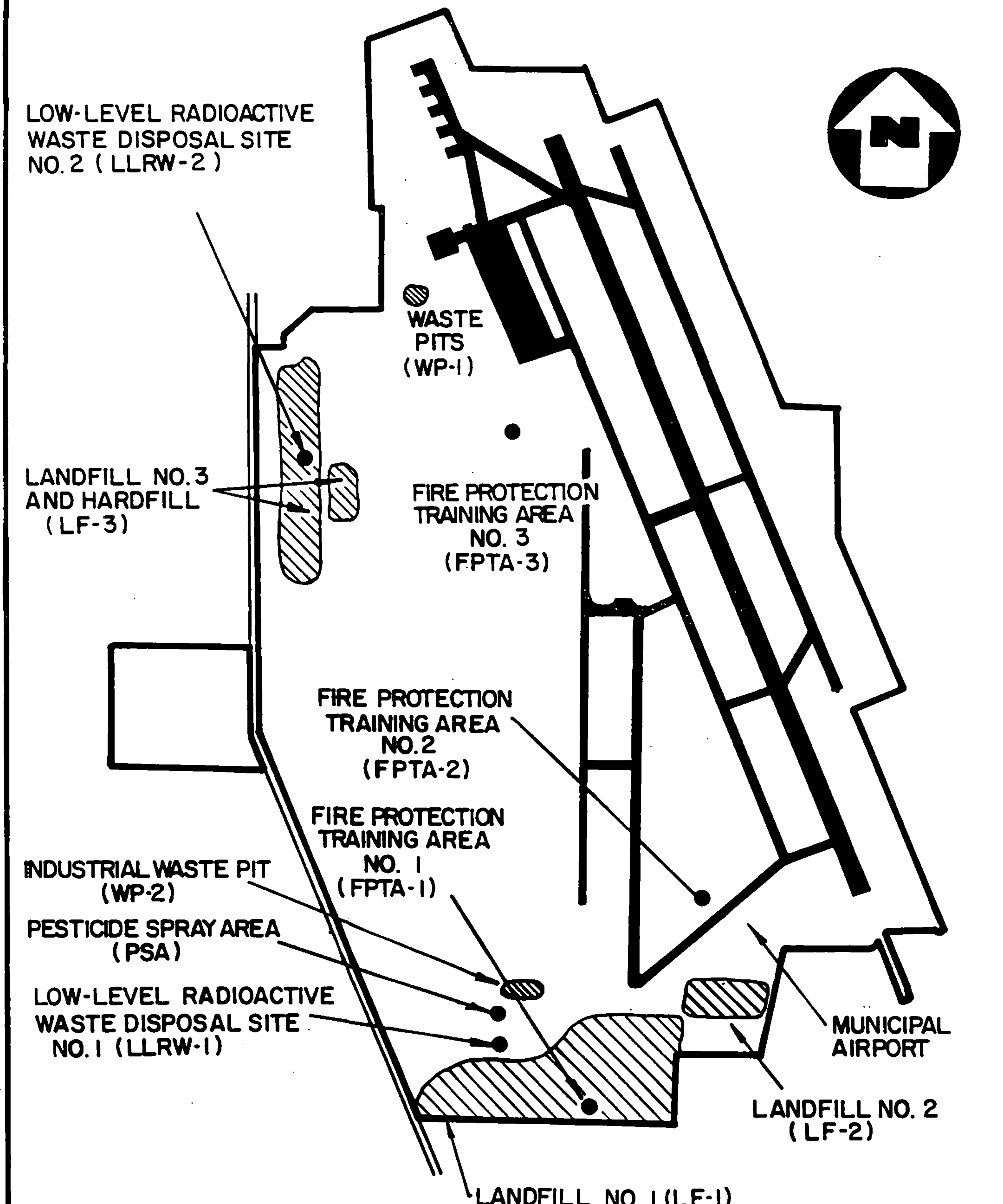

FIGURE 2-3 SITE LOCATIONS
SOURCE: PHASE I - RECORDS SEARCH
FEBRUARY, 1984

SHEPPARD AIR FORCE BASE
SITE PLAN
NOT TO SCALE

NUS CORPORATION

these boundaries gives a total landfill area of approximately 100 acres. The landfill was a trench-and-fill operation, with trenches about 14 feet deep running east-west. Burning of wastes at the site occurred regularly throughout its period of use. The wastes were primarily normal base refuse, but some additional materials were disposed of, including incinerator ash, sludge from the wastewater treatment plant drying beds, and some hardfill and construction rubble. Important considerations at Landfill 1 are the adjacent structures, which include the wastewater treatment plant, a small low-level radioactive waste disposal well, an early fire protection training area, and an ordnance building. The wastewater treatment facility and radioactive waste well are in the area north of the landfill site; the other structures were removed for golf course construction. Most waste-combustible liquids were used in fire protection training. Hence, it is assumed that little or no waste fuel and oil was deposited in this landfill.

2.3.3 Landfill 2 (LF-2)

Landfill 2 is a rectangular-shaped area approximately 7 acres in size (see Figure 4-3). It is located south of the present municipal airport complex and was operated for about 3 years during the early 1960s. Landfill operations entailed trench-and-fill procedures; trenches ran east-west and were approximately 10 to 14 feet deep. As far as can be determined, only normal base refuse was disposed of in Landfill 2. Burning of the refuse was performed during the period of use. At the present time, the landfill area is covered with natural local vegetation. The site formerly occupied by the trenches contains a growth of mesquite trees, which is noticeably more dense than that of the surrounding area.

2.3.4 Landfill 3 (LF-3)

Landfill 3, comprising about 60 acres at the northwest corner of the Base, was operated from about 1957 until 1972. The landfill area is located east of State Highway 240 and in an area bounded approximately by Missile Road, the Motor Pool area, the Munitions Storage area, and the City of Wichita Falls treatment facility property (see Figure 4-4). Included as part of LF-3 is a disposal area for hardfill and other construction rubble that has operated at a site adjacent to LF-3, approximately 800 feet southwest of the southwest corner of the Munitions Storage area. Interviews with base personnel and examination of aerial photographs provide an indication that the hardfill disposal site was used in the mid-1960s and continues in limited use at the present time. When first opened, the site was used primarily for normal base refuse; after the addition of construction rubble from the 1964 tornado damage of the Sheppard Hospital, the site was used as a hardfill area. As far as can be determined, no waste fuels, solvents, or oils were disposed of in this area. Low-Level Radioactive Waste Disposal Area 2 (LLRW-2) is located near the center of LF-3. Part of LF-3 is presently used as a grenade launcher and small arms range. The material disposed of in this landfill was primarily normal base refuse and some waste treatment sludge; the operation was performed as trench-and-fill with east-west trenches approximately 14 feet deep. Burning of the refuse occurred until 1968, after which no further burning was performed. Landfill 3 was first opened near Missile Road. It was progressively opened north to northeast, so that by the early 1970s, the area of use was west of the Munitions Storage Area. From approximately 1965 to 1970, trenches at the north area of the landfill, near Munitions Storage, received waste oils and refuse. Volume estimates ranged from one 55-gallon drum per week to one 55-gallon drum per day.

A subsurface investigation was conducted at LF-3 in conjunction with the Phase II report. The soil at the site consisted primarily of clayey silts. Ground water was encountered at two locations at the north and south ends of the landfill near the unnamed creek. Mercury was found to exceed Federal and State of Texas primary drinking water standards in ground-water samples collected from these wells during the first of two rounds of sampling. Two additional borings were drilled within the boundaries of the landfill to depths of 40 and 51 feet but did not encounter ground water. The Phase II report could not conclude that off-base migration of contaminants could be discounted.

2.3.5 Fire Protection Training Area 1 (FPTA-1)

Site FPTA-1 was located within Landfill 1 (see Figure 4-5) and used as a fire protection training area from 1941 until 1957. The site consisted of a depressed burning area and three old aircraft. A drum storage area north of and adjacent to the site was used to store between 100 and 200 55-gallon drums of contaminated oils, fuels, and waste solvents from aircraft maintenance and industrial shop activities. The frequency and duration of burns during the 1940s is unknown. During the 1950s, drums were transported by flat-bed truck from the drum storage area to the fire protection training site. The drums were drained and, then, burns occurred. During the 1950s, four or five burns occurred each weekend day. Each burn constituted about 400 to 500 gallons of material. As far as can be determined, no drainage collection system was operational at this site.

Visual examination of the area presently reveals no remaining signs that the site was once a fire protection training area. The site is filled in and is a part of the Base golf course. Due to the nature and duration of the activity at this site and the relatively shallow depth to ground water, a potential for contaminant migration exists.

A subsurface investigation was conducted at FPTA-1, in conjunction with the Phase II investigation. The confirmation study installed 4 monitoring wells ranging in depth from 18 to 30 feet and 4 coreholes ranging in depth from 3 to 4 feet. Ground water was encountered from 0.4 to 6.3 feet below ground level. Hydrocarbon and organic contamination is present on the site in the shallow ground water. A suspected contaminant plume was identified by an EM survey. The report stated that the potential exists for on- and off-base contamination (Phase II report).

2.3.6 Fire Protection Training Area 2 (FPTA-2)

Site FPTA-2, located north of the municipal airport terminal and Taxiway C (see Figure 4-6), was used as a small-scale fire protection training area from about 1968 until 1976. Typical usage consisted of one burn of contaminated oil, fuels, and solvents every 3 to 6 months. Portions of an oil-water separator, connected to a storm drain, exist at the site.

The surface soils in this area have been disturbed for construction of runways. Adjacent soils are composed of silty loam with relatively low permeabilities. Ground water may occur at less than 10 feet below ground. A nearby test boring for Runway 33L encountered clay from 0 to 13 feet deep, with two minor lenses of coarse sand and gravel less than 6 inches thick at 7- and 11-foot depths.

2.3.7 Fire Protection Training Area 3 (FPTA-3)

Site FPTA-3, located adjacent to the northern corner of the old municipal runway (presently Bridwell Road), was activated in 1957 when FPTA-1 was closed for construction of the golf course. This site is in use at the present time. The site consists of a storage area containing three 2,000-gallon elevated tanks, a concrete block building, a mock-up of a T-38 used for fire training, a C-130A aircraft for rescue training, and a waste drainage and collection system (see Figure 4-7). The drainage and collection system, installed in 1982, consists of drainage collection and piping leading to an oil-water separator as well as a water storage pond. The unburned fuel, which drains into the oil-water separator, is pumped to the storage tanks for reuse. The water phase flows to the pond, where it is then discharged to the sanitary sewer. Present burn frequency is approximately quarterly, approximately 300 gallons of fuel is consumed per burn. Prior to 1982, no waste collection and separation system was in operation at this site.

Natural soils in the area of FPTA-3 are composed of silty loam with relatively low permeabilities. Ground water seasonally occurs at less than 10 feet below ground. A nearby test boring at Building 2013 encountered clay from 0 to 15 feet below ground.

Visual examination of the area indicated surficial contamination and a fuel odor. Due to the duration and frequency of operations, as well as the lack of a waste oil reclamation facility until recently, a potential for contaminant migration exists at the site.

FPTA-3 was subject to a subsurface investigation as part of the Phase II investigation. This study installed 3 monitoring wells ranging in depth from 30 to 35 feet. Ground water was encountered at a depth of 6 feet below ground level. Inorganic and organic compounds were present in the soils and ground water at the site. The geophysical results from the Phase II investigation show two anomalous areas: one northeast of the present evaporation pond and near the former evaporation pond and MW-10; and the other is southwest of the evaporation pond and close to MW-9. Contaminant plumes were not confirmed in these areas.

2.3.8 Industrial Waste Pit (WP-2)

An earthen industrial waste pit, just north of the wastewater treatment facility, was used during the 1950s as a storage pond for waste oils and fuels from the old engine test cells (see Figure 4-8). An industrial waste line ran south from the test cells to the pit. The oils in the pit were burned on at least one or two occasions during the 1950s. The pit is no longer used for industrial waste storage. It is presently used as an overflow basin for the effluents from the oil-water separator.

2.3.9 Pesticide Spray Area (PSA)

Pesticide applications have been performed by the Entomology Shop, Golf Course Maintenance, and Roads and Grounds. In 1979, the responsibility for herbicide application around the base areas other than the golf course was delegated to the Entomology Shop. The Entomology Shop has always been located in Building 4493 adjacent to the waste treatment plant (see Figure 4-9). This building has been used for both storing and mixing the chemicals. Rinse water generated from cleaning the application equipment and empty containers has been dispensed over a gravel lot adjacent to the building. Rinsed containers have been crushed and disposed of with general refuse.

2.3.10 Low-Level Radioactive Waste Disposal Site (LLRW-1)

The disposal well adjacent to the wastewater treatment plant is concrete-lined, about 6 inches in diameter and 14 feet deep, and is surrounded by a locked, fenced area (see Figure 4-9). The well was reportedly installed in the early 1950s for the disposal of X-ray waste from the Sheppard AFB hospital. It is alleged that, on one occasion during the mid to late 1950s, the well was used to dispose of a quantity of material. However, the volume, identity, and source of material are unknown. No written base records are available to indicate whether the site has been used.

2.3.11 Low-Level Radioactive Waste Disposal Site in Landfill 3 (LLRW-2)

The radioactive waste burial vault in Landfill 3 is in a marked area approximately 100 feet square (see Figure 4-4). It is alleged that the site was activated and marked in the late 1950s or early 1960s and that a radioactive tool or wrench used in munitions maintenance may have been deposited in the vault on one occasion. No written base records are available to indicate whether the site has been used.

2.4 BASE ENVIRONMENTAL SETTING

2.4.1 Meteorology

Mean annual precipitation at the base for the period 1948 to 1982 was 27.08 inches (Phase I Report), whereas annual lake evaporation for the area is 64 inches (NOAA, 1979). The 1-year, 24-hour rainfall intensity is 2.8 inches (NOAA, 1963), which is considered to be moderate. Selected meteorological data for Sheppard AFB are summarized in Table 2-1.

2.4.2 Geography

Sheppard AFB is located in Wichita County, Texas, which is in the north-central portion of the state. The base is located 4 miles north of Wichita Falls and about 5 miles south of the Texas-Oklahoma state line at the Red River. The main installation covers about 5,249 acres of gently rolling prairie. Nearby urban areas are generally small (less than 1,000 population*) and widespread with the exception of Burkburnett (population 10,668) and Wichita Falls (population 94,201*), which is the county seat. Rural areas surrounding Sheppard AFB are agricultural. Alfalfa and wheat are the major crops. Towards Wichita Falls, the area is largely commercial and residential.

2.4.3 Geology

Sheppard AFB is underlain by residuum and bedrock of the mid-Permian aged Petrolia Formation (formerly the Wichita Group) which exceeds 350 feet in thickness. The Petrolia consists chiefly of reddish-brown shale and mudstone with lesser amounts of sandstone, conglomerate, and limestone. The shale and mudstone consist of crudely stratified silts and clays commonly with calcareous nodules and occasional plant and animal fossils. Sandstone occurs as red-to-yellowish brown, thinly bedded layers and thicker sequences representing channel fill deposits. Sandstone members range in thickness from 3 to 25 feet (Barnes, 1987) and generally occupy topographically high areas of the otherwise gently rolling terrain.

The Petrolia Formation is typical of other Permian-aged deltaic deposits found elsewhere in north-central Texas, since the depositional environment consisted of a complex array of fluvial, lagoonal, and floodplain deposits. The resultant stratigraphy consists of discontinuous sands interbedded with extensive deposits of silt and clay (Brown, 1969).

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* The World Almanac, 1988.

TABLE 2-1

SUMMARY OF SELECTED METEOROLOGICAL DATA FOR SHEPPARD AFB, 1948 TO 1982*

Month	Temperature (°F) Mean Daily Maximum	Precipitation (Inches) Monthly Mean	Snowfall (Inches) Monthly Mean
January	52	0.97	1.9
February	58	1.12	2.0
March	66	1.73	0.9
April	77	3.01	Trace
May	84	4.55	0.0
June	93	2.93	0.0
July	98	2.20	0.0
August	97	2.15	0.0
September	88	3.32	0.0
October	78	2.46	Trace
November	64	1.38	0.4
December	56	1.26	0.9

* Source: Phase I Report.

2.4.4 Topography and Drainage

The topography in the vicinity of the base is typical of the Central Rolling Red Plains physiographic province. This province is characterized by gentle, low rolling hills sometimes separated by large, flat areas of little relief (Phase II report). The Red and Wichita Rivers, which are located north and south of the base respectively, have incised prominent valleys within the rolling terrain.

The topography at the base is gently rolling with the overall relief being less than 100 feet. The elevation ranges from about 1,075 feet National Geodetic Vertical Datum (NGVD) south of the base hospital to about 956 feet NGVD, where Bear Creek exits the eastern base boundary. Locally, the greatest amount of relief occurs in the vicinity of the surface streams, which have cut deeply into the surface soils. Such an area occurs in the vicinity of Landfill 1, where there is approximately 40 feet of relief over a distance of 300 feet.

Sheppard AFB lies within the Wichita River portion of the Red River Drainage Basin. The northern base boundary is about one-half mile south of the divide separating the Red River and Wichita River watersheds. The Wichita River originates approximately 150 miles west of the Base and generally flows east-northeast to join the Red River north of Byers, Texas. The Red River originates in extreme eastern New Mexico and flows southeastward to join the Mississippi River, north of Baton Rouge, Louisiana.

Several man-made features strongly affect the surface water drainage at Sheppard AFB. Concrete-lined ditches serve to route storm runoff through the base operations and residential areas. One ditch drains the southern portion of the Base and serves as the industrial waste line. Moreover, two major tributaries of Bear Creek are channeled into three 72-inch-diameter culverts, which travel beneath the runways. Two retention basins, one located southwest of the Alert Apron and another west of Building 2320, allow runoff to pond, before entering the culverts. One of these ponding areas covers the area of WP-1. Surface water leaving the northern half of the base enters Bear Creek, which flows east to join the Wichita River. Surface water runoff exits the southern portion of the Base and enters either the North Side Canal, Plum Creek, or an unnamed creek; all of which eventually enter the Wichita River, west of Wichita Falls.

2.4.5 Hydrogeology

Shallow ground-water resources are very limited in the vicinity of Sheppard AFB due to the preponderance of clay and silt in the surface soils and the discontinuity of existing sand lenses. Because of the general low yield and poor quality of the shallow aquifers, ground water is generally not utilized for domestic wells in the vicinity of the base.

Although there is no obvious aquifer in the vicinity of Sheppard AFB, some shallow, localized aquifers are present. Ground water, where present, is generally encountered at depths of 10 to 30 feet below the surface. In some areas, ground water was not encountered to depths in excess of 50 feet. Shallow (less than 5 feet) ground water is present near the Operational Apron (Stroman, 1983) and on the base golf course. The shallow ground water beneath the Operational Apron has been attributed to effects of "evaporative pumping" by the heat of the runway on hot, sunny days (Phase I report) and other anthropogenic sources.

Ground-water quality in the vicinity of the base is generally poor, due to limited recharge by precipitation. The ground water derived from the Petrolia Formation is reported to be highly mineralized, based on information derived from driller's logs for oil and gas wells. Development of oil and gas wells may also have contributed to mineralization of the shallow ground water (Baker, 1963).

Ground-water quality is good in wells located within the Quaternary Alluvium and Terrace Deposits north and south of the base, along the Red and Wichita Rivers. The towns of Burkburnett, Thornberry, and Friberg Cooper all derive their municipal water supply from the alluvial deposits associated with the Red River, about 4 miles north of the base. Water resources from this aquifer do not appear to be hydraulically associated with the ground water on the base (Phase I report).

2.4.6 Pedology

Soils on the base are typically poorly drained, sandy, silty, and clayey loam. These soils are derived from in-place weathering of the underlying bedrock. Thus, the type of sand or silt reflects the grain-size characteristics of the bedrock. The general characteristics of the soils likely to be encountered at the 11 sites of this investigation are summarized in Table 2-2.

The soils on the base have poor infiltration characteristics, as defined by the Soil Conservation Service. These soils typically are a sandy or silty loam at their surface. Their subsurface is generally composed of a silty to sandy clay loam or clay (Phase I report).

TABLE 2-2

GENERAL SOIL CHARACTERISTICS
SHEPPARD AFB

Unit Description	Dominant Texture	Vertical Permeability (cm/sec)	Percolation Rate
Asa and Port soils	Silty clay loam	4.2×10^{-4} 1.4×10^{-3}	Not given
Bluegrove loam	Loam	4.2×10^{-4} 1.4×10^{-3}	Slow
Deandale silt loam	Silty loam	$<4.2 \times 10^{-5}$ 1.4×10^{-3}	Slow
Frankirk loam	Loam	4.2×10^{-4} 1.4×10^{-3}	Slow
Kamay silt loam	Silty loam	$<4.2 \times 10^{-5}$ 1.4×10^{-3}	Slow
Oben loam	Fine, silty loam	4.2×10^{-5} 1.4×10^{-3}	Not given
Vernon loam	Clay loam	$<1.4 \times 10^{-5}$	Slow

Modified from Richardson, 1977.

3

3.0 INVESTIGATION RATIONALE

This section contains a summary of the major field and laboratory activities to be performed during the RI investigation and the activity rationale. There are two levels of effort in this WP. The four sites identified for additional study in the Phase I report will undergo a Phase II Confirmation/Quantification - Stage 2 study. The remaining seven sites are subject to Phase II Confirmation/Quantification - Stage 1 site investigations.

3.1 SURVEYING

The accurate determination of data points is an essential part of any hazardous waste investigation. These data points act as the foundation for decisions used while evaluating the various sites. As such, the need for precise reproducible data points, both horizontally and vertically, is required. The surveying task will provide basic control for geophysical grids, monitoring wells, borings, and surface soil samples. These data points will be referenced to the Sheppard AFB grid system and will identify the declination angle between the Sheppard grid system and the Texas State Grid System. This tie is necessary for the data points to be reproducible.

3.2 GEOPHYSICAL INVESTIGATION

3.2.1 Purpose

This section presents the geophysical techniques to be used at the Low-Level Radioactive Waste Disposal Area in Landfill No. 3 at Sheppard AFB. The investigation is designed to locate the burial vault which may contain radioactive material.

Electromagnetic (EM) terrain conductivity and magnetometer surveying techniques will be used at the Low-Level Radioactive Disposal Area. Data collected by these nondestructive geophysical techniques will be supplemented with field observations.

3.2.2 Magnetometry

Detection of buried ferromagnetic objects with magnetometers is based on the fact that magnetization is induced in any magnetic material by the earth's magnetic field. The induced field is superimposed on the earth's magnetic field and, if sufficiently large, can be detected as an anomaly in the ambient field. Both the shape and amplitude of such anomalies depend on the size, shape, depth of burial, orientation, and magnetic susceptibility of the object as well as the direction and intensity of the earth's field at the location of the measurements.

For this study, an EDA Instruments Omni IV Tie-Line Proton Precession Magnetometer and an EDA Instruments PPM 400 Base Station Proton Precession Magnetometer will be used. Both of these instruments are total field instruments (i.e., they measure the magnitude of the earth's field). The Omni IV instrument also has the capability of acting as a true gradiometer. In this mode, a vector component or gradient of the magnetic field is measured. The gradiometer data provide an accurate means of locating the positions of individual sources from the total magnetic field. At all measurement locations, a total field and gradient measurement, will be obtained to enhance interpretation accuracy.

3.2.3 Electromagnetic Terrain Conductivity

Electromagnetic (EM) terrain conductivity instruments are designed to measure the electrical conductivity of the ground by inducing eddy currents in the ground and then measuring the secondary magnetic fields produced. The inducing field is produced by a transmitter coil, which is separated by a fixed horizontal distance from a receiving coil. This type of instrument produces readings of ground conductivity in units of millimhos per meter (mmhos/m) and does not require contact with the ground surface. Therefore, in most cases, EM terrain conductivity methods represent an advance in cost-effectiveness over traditional methods based on direct-current geoelectric soundings.

The quantity actually measured by the EM method is an apparent conductivity of the volume of earth between the ground surface and an effective penetration depth determined by the dimensions and configuration of the instrument. The measured value is a weighted average, such that the conductivities of deep layers of soil and water contribute less to the measured value than do the conductivities of shallow layers.

The response characteristics of the instrument to be used in this survey are such that the response curve will tend to be strongly positive over ferromagnetic objects. Therefore, when large metallic objects are present, the measured conductivity values are not representative of the true ground conductivity.

3.2.4 Data Processing Methods

Both the magnetometer and EM data acquired in this study require processing to be useful and interpretable. The procedures used to process and display these data sets are outlined in the following paragraphs.

Magnetic Data

When collected over a period of several hours, magnetic measurements are often biased by a changing ambient field. These diurnal changes have both periodic and random components, which are related primarily to the effects of changing solar radiation on the electrical currents in the outer atmosphere of the earth. It is, therefore, necessary to monitor the ambient field during a magnetic survey and subsequently correct the survey data for the observed changes in the ambient field. The PPM-400 magnetometer will be set up in the base station mode to assure that the image resolution meets the objectives of this study. This procedure will be done to monitor diurnal changes in the magnetic field. Readings will be recorded automatically every 17 seconds for the duration of the survey. At the completion of each survey day, the data will be diurnally corrected by interfacing both magnetometers. Software in the PPM-400 will correct for diurnal drift and will plot the magnetic profiles. So that the large magnetic data set can be handled efficiently, a computer will be used to produce iso-contour and three-dimensional enhancements of the total field and gradiometer data. This task will be performed using Golden Software's Surfer program.

EM Data

Ground conductivity patterns are more easily interpreted from EM data when the data are displayed in map form with line-contouring to delineate conductivity variations. The EM data will be displayed using the same computer program as that used to make the magnetometer plots.

3.3 HYDROGEOLOGIC INVESTIGATION

The geologic/hydrogeologic investigation will be performed to:

- Gather data on the site stratigraphy.
- Characterize aquifer trends.
- Provide a means of subsurface-soil and ground-water sample collection.
- Assess subsurface contamination pathways.
- Collect subsurface-soil samples.
- Perform Soil Organic Vapor (SOV) monitoring.

A total of 13 soil borings will be completed as shallow monitoring wells (approximate 25-foot depth) if ground water is encountered. The actual locations may be modified in the field as determined by the site geologist. Twenty additional borings/monitoring wells are proposed for use if contamination is encountered.

Site stratigraphy will be characterized by the cuttings, split-spoon, and continuous core samples from the monitoring well borings and soil borings will be logged in the field by the site geologist. The split-spoon samples will be collected at 5-foot depth increments (or less, based on changes in pedology). At least one continuous core sample per site will be collected utilizing a Christensen core sampling device. The core samples will be placed in a standard core box and kept for the duration of the field effort to aid in pedologic correlation between boring locations. This information will be used by the project geologist to

- Describe the site geology.
- Prepare geologic cross-sections.
- Evaluate geologic influence on the occurrence and movement of ground water and contaminants.

All samples will be field-screened by the site geologist using a photoionization detector (PID). A minimum of one soil sample from the vadose zone, or first saturated zone encountered by the drilling, will be collected for laboratory analyses. Soil samples from shallower depths may also be collected for laboratory analyses, based on the results of field screening. Analyses of these samples should provide information regarding

- Source contamination.
- The migration of contaminants through the vadose zone.
- The areal distribution of "floating" contaminants, which are of concern at each of the sites.

Monitoring wells will be installed to obtain hydrogeologic information and ground-water samples. The wells will be installed using the air rotary drilling technique. Drill cuttings, split-spoon, and continuous core samples will be logged, sampled, and preserved as described above. The wells will be constructed of 2-inch-diameter PVC materials, with a 10-foot screened interval across the water table in the shallow wells and a 10-foot screened interval at the bottom of the deep wells. The wells at Fire Protection Training Areas 1 and 3 will be constructed of 4-inch-diameter PVC material, due to the potential for future recovery from these wells.

Aquifer slug tests will be conducted at sites having two or more monitoring wells. The information from these tests will allow for estimates of hydraulic conductivity of the water-bearing zones (being intercepted by the monitoring wells) on a site-specific and base-wide scope. The slug tests will be conducted by inserting a pressure-sensitive device into the well, lowering the water level in the well, and recording the response of the rising water level versus time. The Bouwer-Rice methodology for interpreting slug test data will be used to calculate hydraulic conductivity.

Analyses of these data will provide the following information:

- Ground-water flow direction and gradient.
- Ground-water flow velocity.
- Information on the presence or absence of various contaminants.

The Soil Organic Vapor (SOV) for Volatile Organic Contaminants (VOCs) will be conducted at LF-1, FPTA-1, and FPTA-3. NUS plans to collect soil gas samples from 80 locations. Sixty of these locations are considered to be of primary interest while the remaining 20 samples will be collected at the option of HAZWRAP. The sampling locations will be staked in the field for subsequent surveying activities.

A Vadose Zone Sampling Probe (VSP) system manufactured by K-V Associates will be used for SOV sample collection. The probe consists of interconnecting stainless-steel tube sections 3 feet long by 7/8-inch diameter. A slotted intake section at the bottom of the probe may be fitted with a variety of driving tips for use in coarse soils, silts, or clays. An electric hammer, powered by a portable generator, will be used to drive probes to the desired depths. Driving may be stopped at any depth, permitting sampling to occur at a number of points within the same hole.

A small vacuum pump is connected to the probe for SOV sample extraction by one of the two following techniques. With the first technique, the pump is connected directly to the probe with Tygon or Teflon tubing. A gas syringe is inserted into the tubing and gas is drawn into the syringe. The syringe is then used to inject the sample directly into a gas chromatograph. The second technique involves placing an air sampling bag in an airtight box which is, in turn, connected to the probe. The vacuum pump is used to evacuate the box and the resulting pressure drop causes the bag to fill with an SOV sample.

Before sampling begins, the pump will be used to purge approximately 1.5 probe volumes to eliminate ambient air from the system. Following purging, soil vapors will be allowed to equilibrate for 5 minutes before sampling is begun. The VSP will be decontaminated periodically to prevent cross-contamination.

Soil-gas samples will be injected into and analyzed using a Photovac 10S50 portable photoionization gas chromotograph (GC). The soil gas samples will be analyzed in accordance with NUS Corporation Standard Operating Guideline (SOG) Volatile Organic Compound Analysis Screening Procedure using the Photovac 10S50 Gas Chromatograph.

3.4 LABORATORY ANALYSES

This task encompasses the laboratory functions necessary to receive field samples, analyze the field samples, and report the results of those analyses.

Preliminary information indicates that a wide range of wastes may have been disposed of at the various sites at Sheppard AFB. Consequently, the chemical analytical program must be sufficiently comprehensive to span the spectrum of chemicals likely to be present. Based on the information contained in the Phase I and Phase II Reports, the following groups of analytical parameters will be used to assess the presence of contamination in soils, ground water, surface water, and sediments at Sheppard AFB:

Analytical Category	Basis for Selection
Volatile Organics, TCL	Widespread use of organic solvents in equipment maintenance. Aromatic volatiles are present in fuels.
Priority Pollutant Metals and Cyanide	Possible disposal of metal and cyanide-bearing wastes and sludges. Heavy metals are found in many paints. Records search revealed silver, cadmium, chromium, mercury, copper, and other metal waste are generated on site.
Base Neutral/Acid Extractables	Possible disposal and burning of high-molecular-weight organic wastes containing polycyclic aromatic hydrocarbons, phthalate esters, and phenolics.
PCBs and Pesticides	PCBs are often found in waste oils, which may have been disposed or burned at the site. A pesticide rinsate disposal area exists on site.
Common Anions, Total Dissolved Solids	Typical constituents of landfill leachates which serve as indicators of leachate migration.
Cation Exchange Capacity	Used to determine capability of soils to attenuate contamination (i.e., heavy metals).
Radiological Parameters	Two radiological disposal sites exist at Sheppard AFB.

Due to the nature of and the limited historical information regarding the two radiological waste disposal sites, the following laboratory analytical program will be followed for radiological analyses if borings/monitoring wells are installed. Gamma Spectrometry analysis will be conducted on both soil and ground-water samples because it can accurately identify and quantify radioactive cesium levels and most effectively identify the presence of radium decay series intermediates in soils. Gross alpha and gross beta determinations on soil samples are of little significance, due to the limited penetrability of particle radiation.

Gross alpha and gross beta analyses are of significance when applied to water samples. These parameters are excellent indicators of contamination of a ground-water aquifer by radioactive waste. If levels of gross alpha and gross beta radiation exceed Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and are not indicative of pervasive background radiation levels, individual alpha- and beta-emitting isotope identification may be required.

Many of these groups contain chemicals that are mobile in ground water (i.e., volatiles and phenolics). Other groups, such as the BN/A extractables and PCBs, are less mobile. However, all are essentially persistent in the environment. Therefore, if chemicals belonging to these groups were disposed of at this site, there should still be sufficient residual contamination in soils and ground water to allow detection with the analytical methods proposed.

Tables 4-4 through 4-15 provide the total quantity of each type of analysis to be submitted to the fixed base laboratory, less QA/QC samples (see Appendix B, Section B.3.3, for definitions) that will be generated, as well as the EPA method reference applicable to each analysis. Appendix B provides the QA/QC procedures that will be followed by the laboratory when it analyzes the samples and the deliverables required for each parameter.

Section 3.5, Environmental Sampling, provides information on the number of samples at each site. That section also provides information on sample holding times, preservation, and sample containers.

3.4.1 Field Tests

Tables 4-4 through 4-15 do not show the field tests to be conducted on ground-water samples because these tests will be uniformly applied to all ground-water samples and because of these tables' space limitations. The field tests to be applied to the ground-water samples are:

Field Test	Method
Specific Conductance	E120.1
pH	E150.1
Temperature	E170.1

3.4.2 Cation Exchange Capacity (CEC)

CEC is an important parameter indicating the potential for contaminant sorption and retardation in porous media. Measurements will be employed in saturated-media contaminant transport models, if modeling is utilized. Ground-water flow and contaminant transport must be evaluated for the risk assessment. For this reason, contaminant retardation in ground water must consider the factors affecting sorption base-wide; therefore, CEC measurements are being taken at every site.

A maximum of one subsurface soil sample from each boring will be tested for CEC. These analyses will be necessary for use in exposure assessment/contaminant transport assessments. This analysis has not been included in the site-specific rationale because it is identical for each site.

3.5 ENVIRONMENTAL SAMPLING

All activities pertaining to environmental sampling (e.g., methodology, equipment decontamination, health and safety, sample management, etc.) will be performed in accordance with applicable state and U.S. Environmental Protection Agency (USEPA) procedures and protocols. Sample collection methodologies and equipment decontamination are discussed in Sections 3.9.1 through 3.9.6. Health and safety procedures are presented in Appendix A and sample management procedures are presented in Appendix B.

3.5.1 Subsurface-Soil Sampling

Subsurface environmental soil samples (i.e., split-spoon samples) will be collected at 5-foot intervals, during the installation of soil borings and monitoring wells, to determine subsurface pedology and subsurface soil contamination. Upon removal from the borehole, each sample will be visually classified, logged, and screened with a PID to give an indication of soil contamination. The PID detects, measures, and provides a direct reading of the total concentration of a variety of trace gases and, thus, indicates the presence of volatile organic compounds.

The field screening will be conducted by placing the soil sample into an air-tight glass container. Following sample vapor equilibrium, the PID probe will be used to puncture the air-tight seal. A reading of head-space vapors will then be recorded in parts per million.

Based on the results from head-space vapor screening, the site geologist will determine which soil samples will be sent to the laboratory for chemical analysis.

These samples will be placed in appropriate sample containers using stainless-steel spatulas and/or spoons.

3.5.2 Surface Soil Sampling

Surface soil samples will be collected from a 2-feet by 2-feet square area within the boundary of each site, as determined by the NUS geologist. Soil will be removed from the four corners and the center point of the square to a depth of approximately 0-6 inches using a stainless-steel trowel. Deeper surface soil samples will be obtained to a depth of 5 feet at the FPTA-2 and the PSA using either a hand auger or Shelby tube. Soil to be analyzed for volatile organics will be placed immediately into the appropriate sample jars. The remaining soil will be composited in stainless-steel mixing bowls and placed into appropriate sample containers. In addition, two "background" samples will be collected from a supposedly "clean" area on the base to act as a control point for comparison.

3.5.3 Ground-Water Sampling

Prior to collecting ground-water samples from a given well, the well will be tested to determine whether a floating contaminant layer is present. A nondedicated, clear bailer will be lowered into the monitoring well until it is approximately half-full. If a floating layer is present, the contents of the bailer will be poured into an appropriate sample container. The two-phase sample will be shipped as a "high hazard" material, phase-separated at the laboratory, and the floating layer will be analyzed. Following this sampling, the well will be purged and sampled as described elsewhere in this section. Any floating layers in subsequent samples will be removed in the laboratory and discarded, leaving only the aqueous layer for analysis.

Ground-water samples will be taken from each monitoring well after purging is complete. The purging procedure will be preceded by the calculation of the number of gallons in one well boring volume. The calculation requires that four variables be known:

- Piezometric surface elevation
- Bottom elevation of sampling well

- Inside radius of sampling well
- Radius of the boring

One well volume, in gallons, is calculated by the formula:

$$V = [\pi r^2 h + (\pi R^2 h - \pi r^2 h)0.30]\ 7.48$$

where:

V = Well volume in gallons
π = 3.14
R = Radius of the boring in feet
r = Outside radius of the well screen in feet
h = Difference between the piezometric surface elevation and the bottom of well in feet
0.30 = 30 percent porosity of gravel pack
7.48 = gallons per cubic foot

Wells will be purged with an electric submersible pump, an electric surface pump, or a stainless-steel bailer. Three volumes of water will be purged from each well (or until dry) prior to sampling. Pumps will be equipped with discharge lines that consist of flexible or rigid, dedicated PVC pipe. Submersible pumps will be lowered using steel cable. Purged water will be discharged to the ground surface and allowed to infiltrate/evaporate. Care will be taken to ensure that this water does not enter drainways, storm sewers, surface water bodies, etc.

Upgradient wells will be purged and sampled first to guard against cross-contamination from downgradient wells. If a well will not produce at least three volumes, it will be evacuated to dryness and allowed to recharge 24 hours before sampling. The site hydrogeologist will be consulted regarding the sequence of well sampling. The quantity of discharge water will be measured using a vessel of known volume.

Monitoring wells will be sampled within 24 hours of purging. All samples will be collected with dedicated, stainless-steel, bottom-loading bailers. The bailers will be lowered using dedicated polypropylene rope.

Ground-water samples will be transferred from the bailers directly into sample containers. Samples to be analyzed for volatile organic aromatics (VOAs) will be collected first. The VOA vials will be filled completely to the top by slowly pouring the water along the side of the vial. This procedure will reduce the loss of volatiles through agitation. VOA vials will be checked for bubbles after filling. Water to be analyzed for nonvolatile fractions will be placed into appropriate sample containers.

Ground-water samples occasionally have suspended solids, which can contain mineral material as well as suspended organics. The presence of suspended solids is indicated by turbidity in the sample. Turbidity can introduce errors in the chemical analyses in the following two ways:

- The undissolved mineral material (i.e., solids) may be dissolved upon acidification, which is routinely performed to preserve certain samples for inorganic analyses. The result is a high inorganic content in the sample.

- Suspended organic materials may act as adsorption media for hydrophobic organics, such as PCBs and BN/A extractables. During sample analysis, adsorbed organics can be analyzed along with those which were true solutes in the sample. The result is an erroneously high concentration of the adsorbed chemical.

To prevent inaccurate analytical results due to suspended solids (i.e., turbidity) in samples, NUS will take the following measures when obtaining all ground-water samples:

- The Sampling Team Leader will visually determine whether the sample is turbid.

- All inorganic samples, whether turbid or not, will be filtered in the field using a 0.45 um (micron) pore diameter filter to remove suspended solids. The sample will then be acidified and sent for analysis.

- If a turbid sample is being submitted for organics analysis, it will be identified as such by the Sampling Team Leader. Upon arrival at the laboratory, the sample will be centrifuged before extraction to remove the suspended solids.

Static water levels will be recorded for each monitoring well before purging. Specific conductivity, pH, and temperature will be measured for each sample collected.

3.5.4 Surface-Water Sampling

Surface-water samples will be collected from impoundments, intermittent drainage structures (if flow is present), and streams. Stratification, if observed in surface impoundments, may necessitate the collection of specific, at-depth samples. The determination of the sample depths will be made by NUS sampling personnel, based on field measurements of water depth, temperature, and conductivity.

Surface-water samples will be obtained by the following methods, as site-specific conditions warrant:

- Dipping the sample containers directly into the water body.

- Scooping the samples with a telescoping aluminum pole and attached stainless-steel container.

- Collecting at-depth samples with a Kemmerer bottle or other similar device.

Temperature, pH, and conductivity testing will be performed for each sample. Care will be taken to minimize disturbance of the water column during sample collection and transfer.

3.5.5 Sediment Sampling

Sediments will be collected using stainless-steel scoops and/or hand corers to the desired depth. Transfer of the sediment into appropriate sample containers will involve the use of stainless-steel spoons. Care will be taken to minimize sediment disturbance while collecting each sample.

3.5.6 Sampling Equipment Decontamination

The decontamination of sampling equipment is necessary to minimize the spread of contamination to clean zones, reduce exposure to personnel, and reduce the possibility for cross-contamination. The potential for cross-contamination during sampling activities will be reduced by observing the following precautions:

- Wear disposable gloves during sampling.
- Change gloves between samples.
- Prevent equipment contact with the ground.

Decontamination stations for personnel and sampling equipment will be set up at each site. Spent decontamination fluids will be disposed of as follows:

- Aqueous (i.e., potable water, detergent/water solutions, nitric acid*, and deionized water) - discharge to ground surface and allow to infiltrate/evaporate.

- Organic (i.e., methanol and hexane) - collect in either metal or glass bowls and allow to evaporate.

Soil Sampling Equipment Decontamination Procedures

Whenever possible, stainless-steel spoons and stainless-steel mixing bowls will be dedicated for taking one sample only. Both dedicated and nondedicated sampling apparatus will be decontaminated via the following eight-step procedure:

- Wash with Alconox detergent and potable water.
- Rinse with 10 percent nitric acid (if metals are to be analyzed).
- Rinse with potable water.
- Rinse with methanol.
- Rinse with hexane (if pesticides are to be analyzed).
- Rinse with deionized water.

* Spent nitric acid solution will be diluted in a glass bowl with other aqueous fluids prior to ground application.

- Air dry.
- Wrap in aluminum foil.

Water Sampling Equipment Decontamination Procedures

Surface and/or submersible pumps will be cleaned in the following manner:

- Wash with Alconox detergent and potable water.
- Rinse with deionized water.

Discharge lines and bailers will be dedicated for use on each monitoring well.

3.6 DATA VALIDATION

Proper interpretation of the laboratory data is best served by the performance of data validation, reduction, and evaluation. This data validation task provides for reviewing the raw analytical data reported by the laboratory and determining the suitability of data for use in subsequent, data-sensitive evaluations.

Data validation consists of review of laboratory results by an NUS chemist, not affiliated with the NUS Laboratory, according to the criteria presented in Appendix E, Validation Guidelines. The purpose of this review is to evaluate the results for inconsistencies in sampling, shipping, and testing as well as determine results that may affect interpretation of the data or conclusions. The laboratory data should be considered incomplete until validation is completed.

Data reduction consists of inputting the validated data into the NUS data base, so that they can be presented in an organized format.

Once the data have been reduced, they will be evaluated to provide an estimate on how definitively source areas and the extent of contamination can be identified. The evaluation will consider the adequacy of the data base and identify data gaps that may require further investigation. NUS will notify HAZWRAP whenever it becomes apparent that additional field or analytical activity is needed, in order to coordinate further actions. Where sufficient data are available, a risk assessment will be performed.

3.7 PUBLIC HEALTH AND ENVIRONMENTAL ASSESSMENT

The field investigation and analytical programs were developed in response to the data requirements to support a public health and environmental assessment. Using the information generated by the field and analytical programs, a risk assessment will be performed to identify threats to the public health or the environment that may be posed by each studied site. Public health and environmental concerns include exposure to hazardous wastes and contaminated air, ground water, soils, and surface water.

3.8 RISK ASSESSMENT OBJECTIVES AND METHODOLOGY

After the field investigation information has been evaluated and the data base (including the results of a receptor study) for the site has been established, a baseline risk assessment will be performed. The objective of this assessment is to characterize the current and potential public health and environmental risks that would prevail if no further action is taken. The risk assessment will focus on exposure to ground water, soil, surface water, and air. A discussion of the risk assessment methodology is provided below.

The methodology employed will incorporate the principles contained in the EPA Superfund Public Health Evaluation Manual (USEPA, 1986).

The risk assessment process is composed of four components:

- Hazard Identification
- Dose-Response Evaluation
- Exposure Assessment
- Risk Characterization

The hazard identification (sometimes referred to as contaminant identification and toxicological evaluation) and dose-response evaluation will collectively comprise the toxicity assessment for the site. The risk assessment process is completed by integrating the results from the toxicity assessment with the site-specific exposure assessment to yield a complete characterization of risk for a given site.

3.8.1 Hazard Identification

The objective of this component will be to screen the information available on the contaminants present at the site and to identify those contaminants which present potentially adverse effects to the exposed populations. The hazard identification will be presented in terms of toxicity profiles (human and environmental) for the chemicals. Important factors to be considered in the evaluation of each chemical include contaminant release, potential routes of exposure, contaminant mobility, types of toxicological effects (toxicity), and effects from exposure to a mixture of contaminants. The following elements will be presented in this section of the risk assessment:

- Selection of any indicator chemicals

  - Selection process and rationale
  - Presentation of indicator chemicals

- Toxicity review of indicator chemicals

  - Human health effects--both acute and chronic (i.e., systemic, carcinogenic, teratogenic, mutagenic, and reproductive effects).

  - Toxicity to the environment--both acute and chronic effects in wildlife and domestic animals.

The hazard identification section may also include, or be supported by addressing, the following areas:

- Physical-chemical properties of the contaminants
- Biotransformation pathway analysis
- Metabolite toxicologic effects
- Pharmacokinetic (toxicokinetic) properties
- Structure-activity relationships

Available comparative standards for each contaminant identified during the Sheppard AFB investigation will be summarized. The public health and environmental assessment will rely heavily on the comparison of measured and/or estimated exposure concentrations against applicable or relevant and appropriate standards (ARARs).

3.8.2 Exposure Assessment

An exposure assessment will be performed, based on actual measurements (i.e., ground water, soil, and surface water) of contaminant concentrations as well as estimated (i.e., modeled) exposure concentrations. Exposure pathways of concern include ground water, soil, surface water (via ingestion, inhalation, and dermal contact), and air (via ingestion and inhalation). The following components will be addressed in the exposure assessment:

- General Discussion
  - Description of approach and terminology such as "ingestion", "dermal", "acute", and "chronic exposure".
- Characterization of Sources and Contaminant Release Analysis
- Environmental Fate and Transport Analysis
  - Presentation of mobility parameters for the indicator chemicals.
  - Identification of the primary exposure pathways.
- Exposed Population (Receptor) Analysis
  - Identification of human and environmental receptors. In order to identify those receptors, a receptor study will be conducted on a review area with a 2-mile radius from the boundaries of the facility. Within the review area, an inventory of public water-supply wells, private wells, populated areas not served by public water supplies, wetlands, and surface waters will be performed. The receptor study will determine the potential for future development of freshwater resources (i.e., ground

water and surface water) within the review area. Sources which may be utilized for the receptor study include:

Local and regional well registries.
Local tax maps.
Local health department records.
Base planning and land use development plans.
Local and regional municipal land use development plans.
Municipal engineering departments.
Public water supply installations.
Other institutions with interest in freshwater use and development.

In addition, all populated areas (within the review area) that may be affected by airborne contamination will be identified.

- Examination of subsets of human and/or fish and wildlife populations that are high-risk.

- Definition of human and environmental exposure scenarios ("best estimate" and "plausible, worst case estimate" for each exposed population).

- Presentation of the Measured and Estimated Exposure Concentrations

- Integrated Exposure Analysis

  - Integration of the preceeding steps' results to yield a quantitative estimate of the expected exposure levels resulting from actual or potential contaminant releases from the site.

3.8.3 Dose-Response Evaluation

The purpose of this step of the risk assessment process will be to determine the potency for the site-associated contaminants by evaluating documented dose-response relationships. Of most importance for the dose-response evaluation of noncarcinogens are the Acceptable Daily Intakes (ADIs) or Reference Doses (RfDs).

Of most importance for the carcinogens' dose-response evaluation are the Carcinogenic Potency Factors (CPFs).

3.8.4 Risk Characterization

The final component of the risk assessment process is the risk characterization. Risk characterization is the process of estimating the incidence or likelihood of an adverse health or environmental effect under the various conditions of exposure, as defined in the exposure assessment. It will be performed by integrating the information developed during the toxicity assessment (e.g., hazard identification and dose-response evaluation) as well as exposure assessment. It will also result in a quantitative or qualitative characterization of risk for Sheppard AFB.

The following components will be addressed in the risk characterization:

- Characterization of noncarcinogenic risks

  - Characterizing risks from noncarcinogenic compounds involves comparing the expected exposure levels to "acceptable levels." The term "acceptable level" indicates any applicable or relevant and appropriate regulatory criteria, health standards, guidance, or advisories. The expected exposure level (dose) will also be compared to the ADIs or RfDs to provide a qualitative indication of the potential for noncarcinogenic effects.

- Characterization of carcinogenic risks

  - Lifetime excess carcinogenic risks are estimates of the probability or range of probabilities that a specific adverse effect will occur under the conditions of exposure of the human population at risk. Estimated lifetime carcinogenic risks will be calculated for the exposure scenarios identified in the exposure assessment. Comparisons of the estimated lifetime excess cancer risks versus commonly cited measures of acceptable risk will be presented.

- Characterization of environmental risks

  - Characterizing the risks to aquatic life (in surface waters potentially affected by the site) and evaluating the potential for effects upon terrestrial biota will be performed qualitatively. This qualitative characterization and evaluation will be done by comparing measured or estimated exposure concentrations against applicable or relevant and appropriate regulatory criteria, health standards, guidance or advisories (ARARs).

4

4.0 SITE-SPECIFIC REMEDIAL INVESTIGATION ACTIVITIES

4.1 INTRODUCTION

Remedial activities to be conducted during each site investigation are discussed on a site-by-site basis in the following sections. Descriptions of past and present activities at the individual sites and reference to the types of materials lost, spilled, or disposed, have been given in Section 2.3 of this report.

The initial activity at Fire Protection Training Areas 1 and 3 (FPTA-1 and FPTA-3) will be a Soil Organic Vapor (SOV) survey. The initial activity at the Low-Level Radioactive Waste Disposal Site in Landfill 3 (LLRW-2) will be a geophysical survey; no geophysical investigations are planned for the remaining 10 sites. Environmental sampling will initially be conducted at all sites, except for the Waste Pits (WP-1), Industrial Waste Pit (WP-2), Low-Level Radioactive Waste Disposal Site Number 1 (LLRW-1), and LLRW-2 which are proposed as optional, in conjunction with the geologic and hydrogeologic investigations. If ground water is encountered in a boring, a monitoring well will be installed to facilitate the collection of ground-water samples. Monitoring wells are to be constructed with the screened interval set to intersect the water table, to the extent practicable, considering seasonal water-table fluctuations. Additionally, surface soil, sediment, and surface-water samples will be collected at specific sites to aid in the investigation, specifically to evaluate potential hazards to human health. A summary of the sampling program is provided in Tables 4-1 through 4-3.

4.2 WASTE PITS (WP-1)

The Waste Pits were located along Avenue H, across from Building 2325 (Figure 4-1) within the floodplain of Bear Creek. The site is presently a shallow depression and serves as a ponding area for surface runoff. The boundaries of the Waste Pits could not be defined from the electromagnetic survey conducted during the Phase II investigation.

The Waste Pits were subject to a Phase II-Confirmation/Quantification Study (Phase II). In this study, no ground water was encountered to a depth of 45 feet in

TABLE 4-1

EXISTING AND PROPOSED BORINGS AND MONITORING WELLS SHEPPARD AFB

Site	Number of Borings/Wells			
	Existing	Proposed	Optional	Total
WP-1	--	--	3	3
LF-1	--	3	2	5
LF-2	--	2	2	4
LF-3	2	2	3	7
FPTA-1	4	3	--	7
FPTA-2	--	1	2	3
FPTA-3	3	1	3	7
WP-2	--	--	2	2
PSA	--	--	--	--
LLRW-1	--	--	1	1
LLRW-2	--	--	1	1
Base Background	--	1	1	2
Total	9	13	20	42

TABLE 4-2

NUMBERS OF SAMPLES FOR LABORATORY ANALYSIS
(BY SITE AND MATRIX)
SHEPPARD AFB

Site	Soil		Water		Sediment
	Surface[a]	Subsurface	Ground	Surface	
WP-1	--	--	--	--	--
LF-1	1	3	3	1	1
LF-2	3	2	2	--	--
LF-3	2	6[b]	4[c]	2	2
FPTA-1	--	9[b]	7[c]	--	--
FPTA-2	4	1	1	--	--
FPTA-3	--	3[b]	4[c]	--	--
WP-2	--	--	--	--	--
PSA	4	--	--	--	--
LLRW-1	--	--	--	--	--
LLRW-2	--	--	--	--	--
Base Background	1	2	1	--	--
Total	15	26	22	3	3

a "Surface" soil is defined as soil obtained at a depth of 0-3' below grade.
b Three subsurface soils will be analyzed from each boring at the three "Phase II" sites (Radian, 1987).
c Ground-water samples will be taken from all existing monitoring wells.

TABLE 4-3

NUMBERS OF OPTIONAL SAMPLES FOR LABORATORY ANALYSIS (BY SITE AND MATRIX) SHEPPARD AFB

Site	Soil		Water		Sediment
	Surface[a]	Subsurface	Ground	Surface	
WP-1	1	9	3	1	1
LF-1	1	6	2	--	--
LF-2	--	6	2	--	--
LF-3	2	9	3	--	--
FPTA-1	--	--	--	--	--
FPTA-2	--	4	2	--	--
FPTA-3	--	6	3	--	--
WP-2	2	2	2	--	--
PSA	2	--	--	--	--
LLRW-1	--	1	1	--	--
LLRW-2	--	1	1	--	--
Base Background	--	2	1	--	--
Total	8	46	20	1	1

Notes:

a "Surface" soil is defined as soil obtained at a depth of 0-3' below grade.

the clayey soils; however, oil and grease contamination was found at depths from 17.5 to 30 feet. A geophysical survey, conducted as a part of this study, failed to discern the boundaries of the original pits or any contaminant plume(s).

The tasks itemized below are optional, pending the review of a Decision Document (DD) by the governing state regulatory agency. Should the DD not be approved, the site activities will proceed as proposed. The initial activities at the site will be the installation of three soil borings to be completed as monitoring wells, pending discovery of ground water. Three subsurface-soil samples will be collected during each soil boring and preserved for laboratory analyses. Subsequently, a sampling team will sample ground water from each installed monitoring well, and collect surface soil and sediment at the site. Analytical results of all soil, sediment, and ground-water samples will be used to determine the presence or absence of target contaminants at the site and to provide information on their spatial distribution.

The rationale for the proposed borings and/or monitoring wells and environmental samples is based upon the following:

- The geophysical survey failed to discern the limits of the site. Additional borings are necessary to better define the location of the Waste Pits.

- The boring locations are in a position generally downgradient from the location of the original pits. Therefore, if ground water is encountered, these wells will be properly placed to intercept any contaminants moving with the ground water.

- The corings and borings placed during the Phase II study were located only within the immediate area of the original pits. The additional borings are located outside of the original Waste Pits, so that they may delineate the lateral extent of contamination.

- Collection of a sediment sample from the nearby creek will enable the evaluation of contaminants and their migration via this pathway.

- Three subsurface-soil samples will be collected from each boring to assess the vertical extent of confirmed oil and grease contamination at this site.

- The surface-soil sample will help to address the dermal, inhalation, and ingestion exposure potential at the site.

Soil Borings (Optional)

NUS will install three soil borings southeast of WP-1, as indicated on Figure 4-1. The exact locations of the borings will be refined in the field, as necessary. The borings will be advanced to a total depth of approximately 50 feet or to 10 feet below the water table, whichever occurs first. The borings will be completed as monitoring wells, if ground water is encountered.

The first boring drilled at this site will be cored continuously to ascertain the general subsurface profile. In subsequent borings, cuttings will be continuously logged and split-spoon samples will be collected at 5-foot intervals or at changes in pedology, as directed by NUS. These data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of three soil samples per boring will be preserved for laboratory analyses. All samples will be screened in the field using a PID instrument. Alternatively, additional samples may be submitted for laboratory analyses, based on the screening results.

Monitoring Wells (Optional)

NUS will install up to three monitoring wells at the location of the soil borings described above. These wells will be installed with a 10-foot screen interval across the water table.

Environmental Sampling (Optional)

Following drilling activities, a sampling team will collect ground-water, surface-soil, and sediment samples at WP-1 (see Figure 4-1). The sample locations are:

- One ground-water sample from each of the monitoring wells (for a total of three samples).

- One sediment sample.

- One surface-soil sample

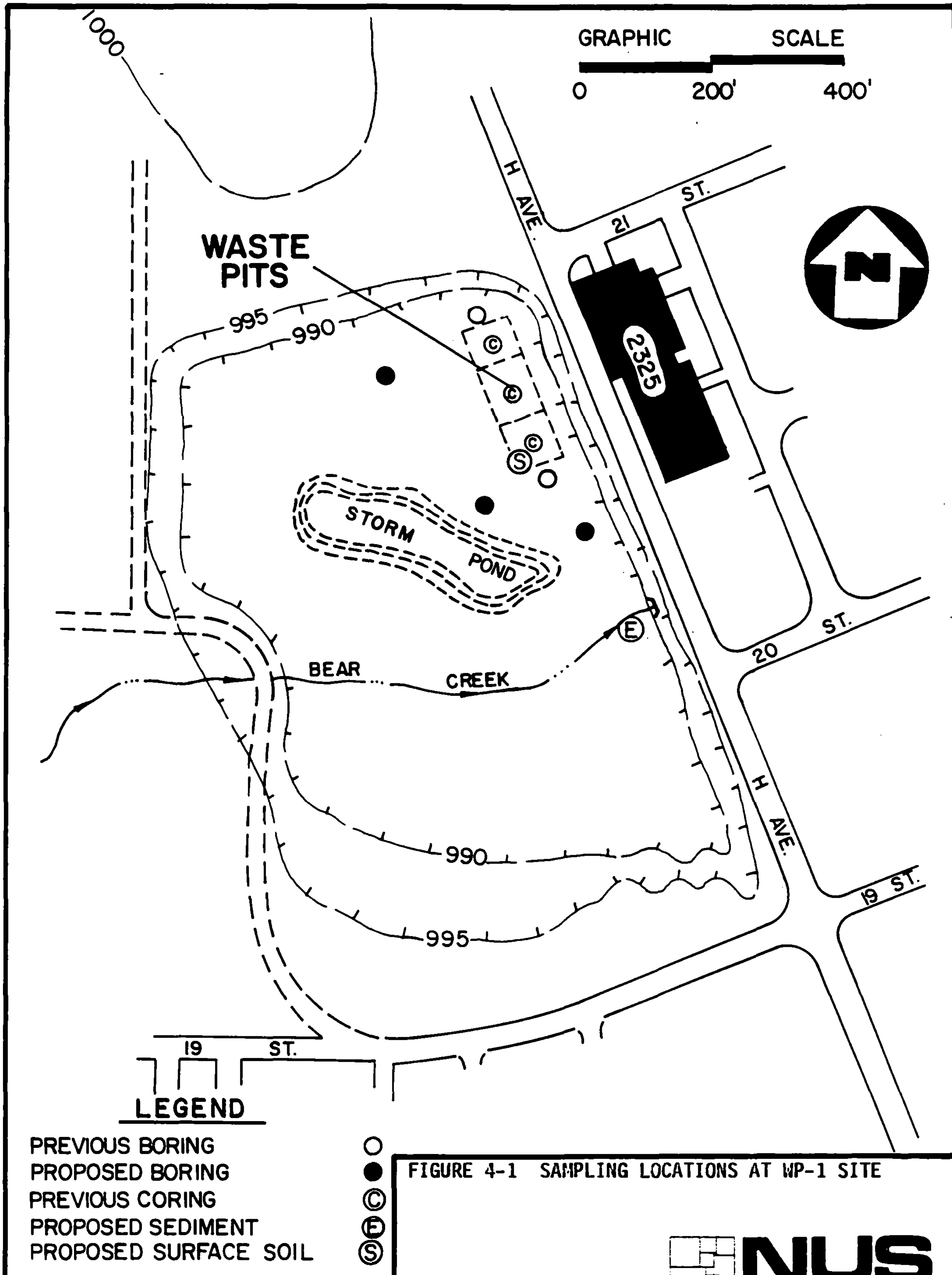


FIGURE 4-1 SAMPLING LOCATIONS AT WP-1 SITE

NUS CORPORATION

Sample Analyses (Optional)

Based on previous sample analyses contained in the Phase II Report and the contamination history of this site (i.e., disposal of waste oils, solvents, cleaning compounds, etc.), all samples will be analyzed for TCL volatile organics, priority pollutant BN/A extractables, 13 priority pollutant metals, and TCL PCBs. One soil sample will be analyzed for cation exchange capacity. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-4.

4.3 LANDFILL 1 (LF-1)

LF-1 is located at the southern end of the base in an area now occupied by the base golf course and a portion of family housing. The site also contains FPTA-1. The exact boundaries of the landfill are not known, but the approximate limits are shown on Figure 4-2. Past records indicate that incinerator ash, sewage sludge, and hardfill were disposed of at this site; however, the possibility of disposal of more soluble contaminants cannot be overlooked. The site is old and records concerning disposal details are incomplete.

The initial activity at the site will be an SOV survey, followed by the installation of three soil borings to be completed as monitoring wells, if ground water is encountered. One subsurface-soil sample will be collected from each boring and preserved for laboratory analyses by NUS. Subsequently, a sampling team will sample ground water from each installed monitoring well, and collect sediment, surface water, and surface soils at the site. Analytical results of all soil and ground-water samples will be used to determine the presence or absence of target contaminants and to provide preliminary information on their spatial distribution.

The rationale for the proposed SOV survey, borings and/or monitoring wells, and environmental samples is based upon the following:

- A portion of the landfill is presently covered by base housing and the golf course. Surface-soil samples and SOV probes are necessary to evaluate potential public health hazards resulting from direct contact or offsite dispersion of contaminants from the surface of the fill.

TABLE 4-4

WP-1 LABORATORY ANALYTES[a] (OPTIONAL)
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	3/--	3
13 Priority Pollutant Metals	EPA Methods	C	3/--	3
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	3/--	3
PCBs (TCL)	CLP	D	3/--	3

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	1	9	1	11
13 Priority Pollutant Metals	EPA Methods	C	1	9	1	11
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1	9	1	11
PCBs (TCL)	CLP	D	1	9	1	11
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

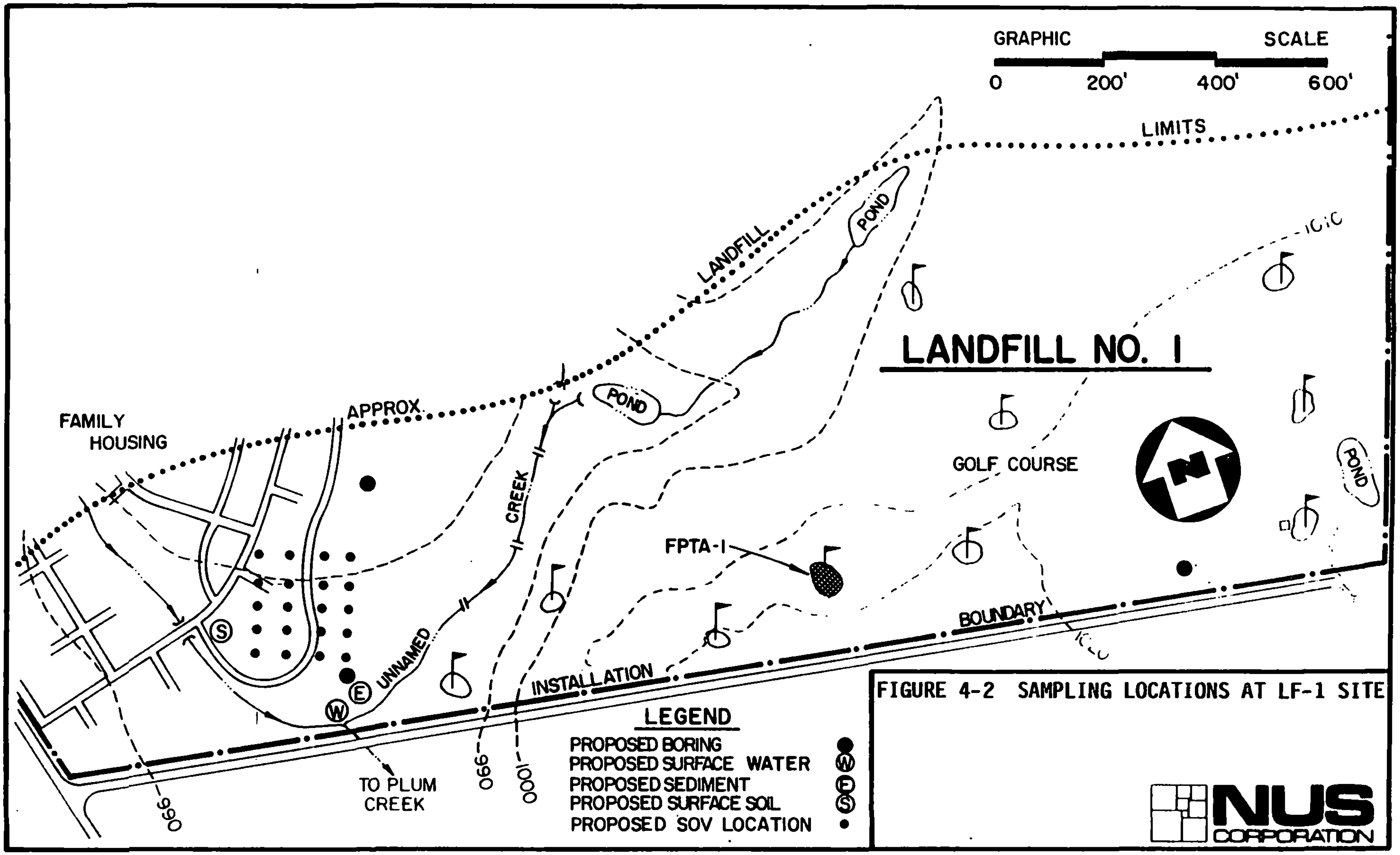


FIGURE 4-2 SAMPLING LOCATIONS AT LF-1 SITE

- The landfill lies in an area with abundant sandy soil and shallow ground water. The borings will aid in understanding the site-specific hydrogeology.

- Two of the borings are positioned generally in downgradient positions, so that they will intercept contaminants which may be traveling with the ground water. Additionally, these two downgradient wells are located at the base boundary to assess any contamination moving off base.

- Due to past construction practices, potential exists for stratified contamination. Three subsurface-soil samples from each boring will be collected to assess the extent of vertical contamination.

- One monitoring well is located in an apparent upgradient position. This well is located near base housing constructed over the landfill in order to characterize the subsurface pathway.

- Collection of surface-water and sediment samples from the nearby creek will enable the evaluation of contaminants and their migration by this pathway.

Soil Organic Vapor Survey

NUS will conduct a soil gas survey at the locations shown on Figure 4-2. The exact locations of the probes will be refined in the field, as necessary. The approximately 20 probe locations will be driven or augered to a depth not to exceed 5 feet. The location of the sampling grid is such that it should detect any contaminated soil gas beneath the base housing. Soil-gas samples will be collected from the borehole by an air pump and sampling device. The samples will be analyzed for volatile organic compounds (VOCs) using a Photovac 10S50 portable photoionization gas chromatograph (GC).

Monitoring Wells

NUS will install three monitoring wells in each of the three proposed borings around the approximate perimeter of the site, if ground water is encountered. The exact locations of the monitoring wells will be refined in the field, as necessary. All three wells will be installed to a depth of approximately 25 feet depending upon the depth to the water table with a 10-foot screen section open across the water table. If ground water is not encountered, the borings will be advanced to a maximum depth of 50 feet.

The first boring drilled at this site will be cored continuously to ascertain the general subsurface profile. In subsequent borings, cuttings will be continuously logged and split-spoon samples will be collected at 5-foot intervals or at changes in pedology, as directed by NUS. These data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of three soil samples per boring will be preserved for laboratory analyses. All samples will be screened in the field using a PID instrument. Alternatively, additional samples may be submitted for laboratory analyses, based on the screening results.

Three optional monitoring wells are reserved for this site (see Section 4.14).

Environmental Sampling

Following drilling activities, a sampling team will collect ground-water, surface-soil, surface-water, and sediment samples at LF-1. The sample locations are illustrated on Figure 4-2 and are as follows:

- One surface soil sample near the location of the base housing.
- One ground-water sample from each installed monitoring well (for a maximum of three samples).
- One sediment sample located downgradient near where an unnamed creek exits the Base.
- One surface water sample located downgradient of the site.

Sample Analyses

Based on previous sample analyses contained in the Phase II Report, the waste disposal history of this site (i.e., construction and general waste disposal, ash, and waste treatment sludge disposal), and the fact that FPTA No. 1 is located within this landfill area, all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. One subsurface-soil sample will be analyzed for cation exchange capacity. Additionally, ground-water samples will be analyzed for pH, common anions, and TDS. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-5.

4.4 LANDFILL 2 (LF-2)

LF-2 is located immediately south of the present municipal airport complex (Figure 4-3) and is reported to be about 7 acres in size, although the site appears to be somewhat larger on some aerial photographs. The site is presently covered by a dense growth of mesquite trees and is used as a bivouac and training area. The site is relatively flat, but its southeast and southwest corners slope to the base boundaries.

The initial activity at the site will be a further review of existing aerial photos to discern the site boundaries for boring placement. Soil borings will then be drilled at the appropriate locations shown on Figure 4-3. Monitoring wells will be installed within the borings, pending the discovery of ground water. One subsurface-soil sample will be collected from each boring and preserved for laboratory analyses by NUS. Subsequently, a sampling team will sample ground water from each installed monitoring well and collect three surface soil samples at the site. Analytical results of all soil and ground-water samples will be used to determine the presence or absence of target contaminants at the site and to provide preliminary information on their spatial distribution.

The rationale for the proposed monitoring wells and surface soil samples is as follows:

- The site is relatively flat, but gently slopes to both the southeast and southwest. The southeast and southwest corners of the site are upgradient from surface-water systems which flow, off the base, through private property. One boring/monitoring well is located within each of these drainage features in order to obtain preliminary hydrogeologic information regarding the subsurface pathway.

TABLE 4-5

LF-1 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER/SURFACE WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	3/1	4
13 Priority Pollutant Metals	EPA Methods	C	3/1	4
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	3/1	4
PCBs (TCL)	CLP	D	3/1	4
Total Dissolved Solids (TDS)	EPA 160.1	C	1/1	2
Chloride	SM 407B	C	1/1	2
Fluoride	SM 413B	C	1/1	2
Bromide	EPA 320.1	C	1/1	2
Nitrate	EPA 352.1	C	1/1	2
Phosphate	EPA 365.2	C	1/1	2
Sulfate	SM 426C	C	1/1	2
Cyanide	EPA 335.2	C	1/1	2

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	1	3	1	5
13 Priority Pollutant Metals	EPA Methods	C	1	3	1	5
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1	3	1	5
PCBs (TCL)	CLP	D	1	3	1	5
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

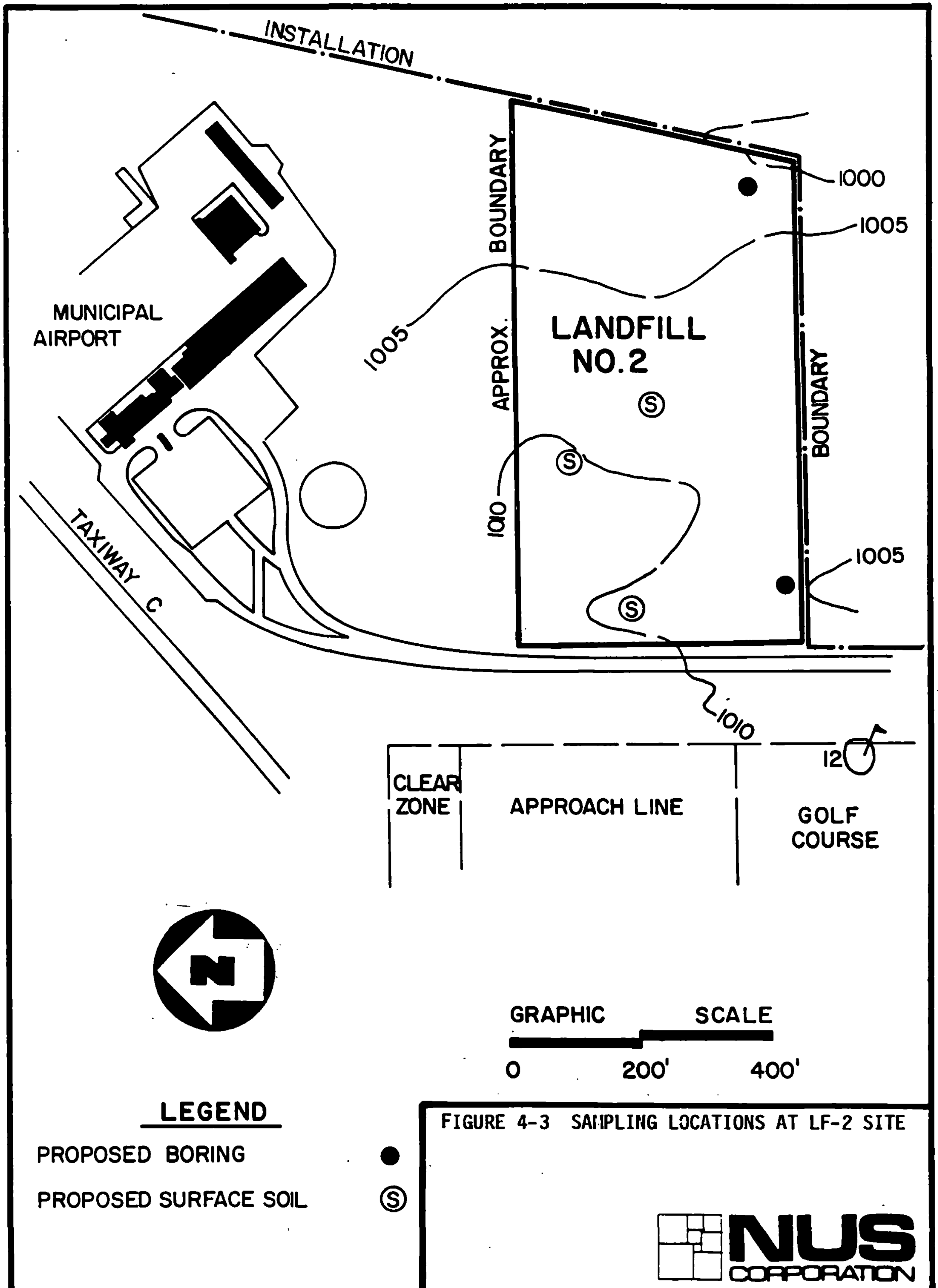


FIGURE 4-3 SAMPLING LOCATIONS AT LF-2 SITE

- The landfill area is in close proximity to observed sandstone outcrops; therefore, sandy soils may be present on the site. The extent of sandy soils is important because it represents areas of accelerated ground-water movement. The borings will aid in determining the location and vertical extent of such sandy soils.

- Soil borings are necessary at this site to determine the pedology of the subsurface soil and to discern the presence of potential contaminant migration pathways.

- The site is presently used by base personnel as a training and bivouac area. These exercises place the personnel in direct contact with the surface soils. Collection of three surface-soil samples will help to address the dermal, inhalation, and ingestion exposure potential at the site.

Soil Borings

NUS will install two soil borings at the approximate southern corners of the landfill, as indicated in Figure 4-3. The exact locations will be specified in the field. The borings will be advanced to a depth of approximately 50 feet. The actual depth will depend on the depth to ground water (i.e., the boring will be terminated 10 feet below the first occurrence of ground water). The borings will be continuously monitored for the presence of ground water and be completed as monitoring wells, if ground water is encountered. Two optional borings are reserved for this site (see Section 4.14).

The first boring drilled at this site will be cored continuously to ascertain the general subsurface profile. In subsequent borings, cuttings will be logged continuously and split-spoon samples will be collected at 5-foot intervals or at pedologic changes, as directed by the on-site NUS hydrogeologist. The subsurface data will be used for geologic and hydrogeologic interpretation at the site. A minimum of one soil sample per boring will be preserved for laboratory analyses. All soil samples and auger cuttings will be screened in the field using a PID instrument. Samples exhibiting high PID readings, obvious staining, or discoloration may be submitted for laboratory analyses at the discretion of the NUS hydrogeologist.

Monitoring Wells

NUS will complete both borings as monitoring wells if ground water is encountered. These wells will be installed at the depth of the water table, with a 10-foot screen interval across the saturated zone.

Environmental Sampling

Following drilling activities, a sampling team will collect ground-water and surface-soil samples at the LF-2 site at the locations shown on Figure 4-3. The surface-soil samples will be collected at three locales within the bivouac and training area.

Sample Analyses

Based on the waste disposal history of this site (i.e., general waste disposal, incineration ash, etc.), all samples will be analyzed for TCL volatile hydrocarbons, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. Additionally, one soil sample will be analyzed for cation exchange capacity, while ground-water samples will be analyzed for pH, common anions, cyanide, and TDS. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-6.

4.5 LANDFILL 3 (LF-3)

LF-3 is located along the northwest side of the base, with its western edge generally parallel to the installation boundary. An unnamed creek runs along the eastern side of the site and passes directly through its northern corner. Low-Level Radioactive Waste Disposal Area 2 (LLRW-2) is located near the center of the site. Part of the landfill site is presently used as a grenade launcher and small arms range, while most of the site is presently used for recreational activities (i.e., horseback riding, jogging, etc.).

A subsurface investigation was conducted at LF-3, in conjunction with the Phase II Report. The soil at the site was found to consist of clayey silts. Ground water was

TABLE 4-6

LF-2 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	2/--	2
13 Priority Pollutant Metals	EPA Methods	C	2/--	2
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	2/--	2
PCBs (TCL)	CLP	D	2/--	2
Total Dissolved Solids (TDS)	EPA 160.1	C	2/--	2
Chloride	SM 407B	C	2/--	2
Fluoride	SM 413B	C	2/--	2
Bromide	EPA 320.1	C	2/--	2
Nitrate	EPA 352.1	C	2/--	2
Phosphate	EPA 365.2	C	2/--	2
Sulfate	SM 426C	C	2/--	2
Cyanide	EPA 335.2	C	2/--	2

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	3	2	--	5
13 Priority Pollutant Metals	EPA Methods	C	3	2	--	5
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	3	2	--	5
PCBs (TCL)	CLP	D	3	2	--	5
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

encountered at two locations near the unnamed creek. Two additional borings were placed within the boundaries of the landfill and did not encounter ground water. Heavy metal contamination was detected in the ground-water samples. The report concluded that off-base migration of contaminants could not be discounted.

The initial site activities will consist of the installation of two soil borings to be completed as monitoring wells, if ground water is encountered. Three subsurface soil samples will be collected per boring and preserved for laboratory analyses. Subsequently, a sampling team will collect ground-water samples from each existing and newly installed monitoring well. Surface-water, surface-soil, and sediment samples will also be collected at the LF-3 site. Results of the analytical data will be used to determine the presence and extent of target contaminants at the landfill.

The rationale for the proposed borings, monitoring wells, and environmental samples is as follows:

- The geophysical survey previously conducted during the Phase II investigation at the site failed to discern the site boundaries. Additional borings will aid in delineating the extent of the fill.

- The site occupies over 60 acres, yet only four borings (two of which were completed as monitoring wells) were installed during the previous investigation. The borings planned during this phase of the investigation will help determine if any potential contaminant pathways exist on the site.

- Three subsurface-soil samples will be collected from each boring to assess the vertical extent of target contaminants at this site.

- The borings are located to fill data gaps for a landfill of this size. In particular, the northern corner of the site near the munitions storage area was reported to have once been the site of fuel burns. One of the borings is proposed for this area.

- Discovery of ground water in any of the borings will enable a determination of ground-water movement and whether there is potential for off-site migration.

- No subsurface-soil samples were collected from the four borings completed in the previous investigation. Subsurface soil samples are necessary to assess the presence or absence of subsurface contamination.

- Sediment, surface-soil, ground-water, and surface-water samples from the site are appropriate, since heavy metal contamination has been documented at the site (i.e., MW-4) and surface water flows through the landfill.

Soil Borings

A total of two borings will be installed by NUS at locations around LF-3, as indicated on Figure 4-4. NUS will determine the exact locations in the field. Borings will be advanced to a depth of about 50 feet. The actual depth will depend on depth to ground water. The borings will be constantly monitored for the presence of ground water and completed as monitoring wells, if ground water is encountered.

The first boring drilled at this site will be continuously cored with a Christensen sampling device. In all subsequent borings, cuttings will be logged continuously, and split-spoon samples will be collected at 5-foot intervals or at changes in pedology, as directed by the on-site hydrogeologist. The soil data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of three soil samples per boring will be preserved for laboratory analyses. All samples will be field-screened with a PID instrument. More than three samples may be taken for laboratory analyses, if high PID readings are encountered. Three optional borings are reserved for this site (see Section 4.14).

Monitoring Wells

NUS will install up to two monitoring wells at the locations of the soil borings described in the previous section. These wells will be screened across the water table with a 10-foot screened interval.

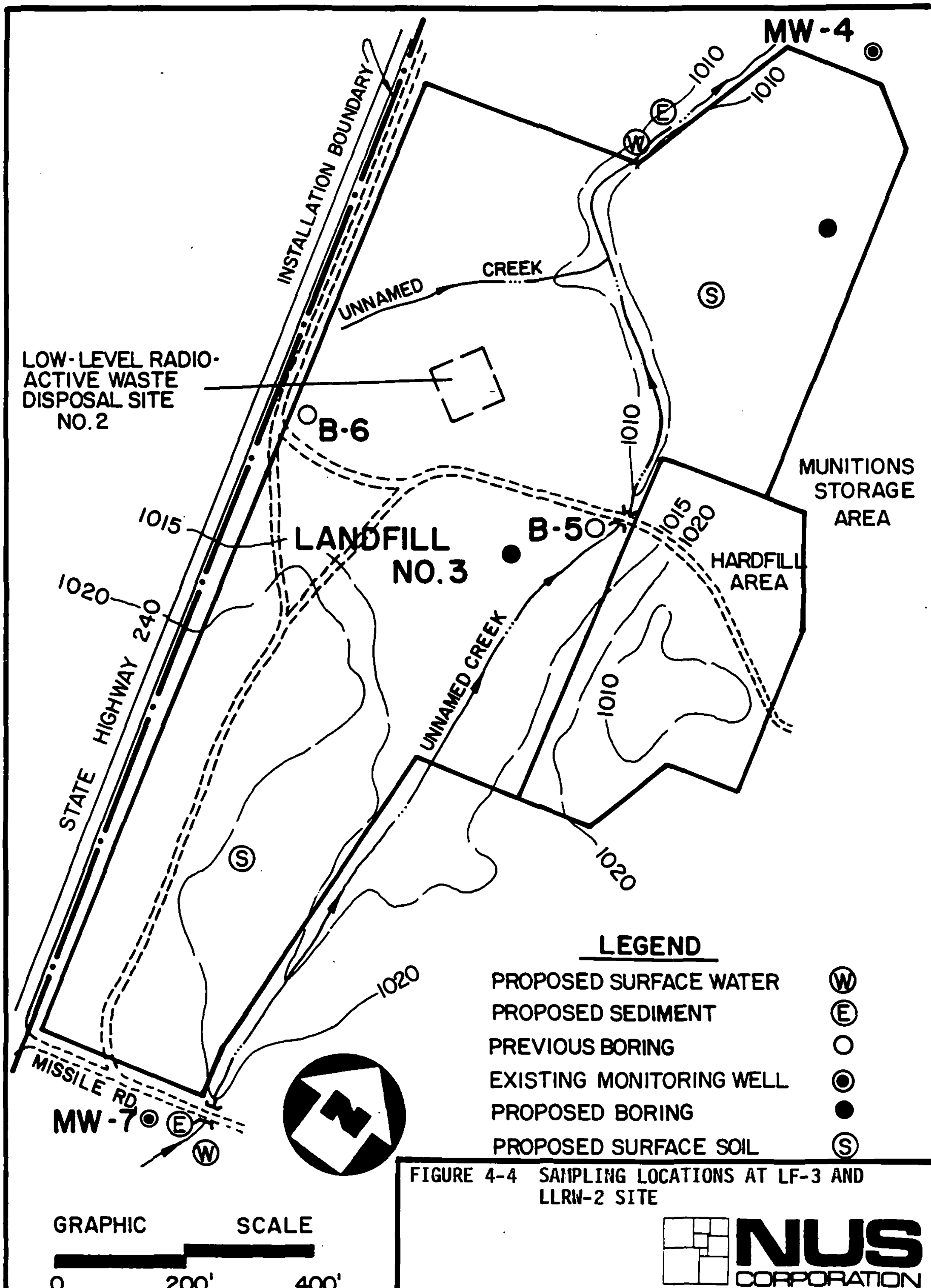


FIGURE 4-4 SAMPLING LOCATIONS AT LF-3 AND LLRW-2 SITE

NUS CORPORATION

Environmental Sampling

Following drilling activities, a sampling team will collect ground-water, surface-water, surface-soil, and sediment samples at LF-3 (see Figure 4-4). The sample locations are as follows:

- Two surface-soil samples within the location of the landfill, one near the grenade launcher range and northeast quadrant, respectively.

- One ground-water sample from each of the monitoring wells (i.e., a total of two samples). Also, one ground-water sample from each of the two existing monitoring wells.

- Two sediment samples: one upgradient and one downgradient from the site.

- Two surface-water samples: one upgradient and one downgradient of the site.

Sample Analyses

A ground-water sample from each well boring as well as two surface-soil samples from this landfill site will be collected and preserved for analyses. Surface-water and sediment samples, from the unnamed stream passing through the landfill, will be taken at upstream and downstream locations to LF-3 and preserved for analyses. Also, ground-water samples from the two existing monitoring wells will be collected and preserved for analyses.

Based on previous sample analyses contained in the Phase II Report and the waste disposal history of this site (i.e., general refuse, waste treatment sludge, waste oil and solvents, and incineration ash), all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. Also, one subsurface-soil sample will be analyzed for cation exchange capacity, while surface-water and ground-water samples will be analyzed for pH, common anions, cyanide, and TDS. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-7.

TABLE 4-7

LF-3 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER/SURFACE WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	4/2	6
13 Priority Pollutant Metals	EPA Methods	C	4/2	6
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	4/2	6
PCBs (TCL)	CLP	D	4/2	6
Total Dissolved Solids (TDS)	EPA 160.1	C	4/--	4
Cyanide	EPA 335.2	C	4/2	6
Chloride	SM 407B	C	4/2	6
Fluoride	SM 413B	C	4/2	6
Bromide	EPA 320.1	C	4/2	6
Nitrate	EPA 352.1	C	4/2	6
Phosphate	EPA 365.2	C	4/2	6
Sulfate	SM 426C	C	4/2	6

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	2	6	2	10
13 Priority Pollutant Metals	EPA Methods	C	2	6	2	10
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	2	6	2	10
PCBs (TCL)	CLP	D	2	6	2	10
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

4.6 FIRE PROTECTION TRAINING AREA 1 (FPTA-1)

FPTA-1 was located within LF-1, approximately at the present location of the Number 2 green at the base golf course. The site was bladed off for construction of the golf course in the late 1950s. Prior to that time, the site was used frequently to burn a variety of waste oils, fuels, and solvents. A subsurface investigation was conducted at FPTA-1, in conjunction with the Phase II investigation. The confirmation study concluded that hydrocarbon and organic contamination are present on the site in the shallow ground water. A possible contaminant plume was identified by an EM survey. The report stated that the potential exists for on base and off base contamination.

The initial activities at the site will be an SOV survey, followed by the installation of three soil borings, which will be completed as monitoring wells. A maximum of three subsurface soil samples will be collected from each boring and preserved for laboratory analyses. Subsequently, a sampling team will sample ground water from the monitoring wells at the site. Analytical results of all soil and ground-water samples will be used to assess the presence or absence of target contaminants as well as their spatial distribution.

The rationale for the proposed SOV survey, borings, monitoring wells, and environmental samples is as follows:

- The SOV survey should identify any contaminant plume migrating along the water table. The probe hole grid is located in a position generally downgradient of the original burn pit.

- The geophysical survey from Phase II detected an area of high conductivity, which may include a contaminant plume northwest of the Number 2 green at the golf course. Additional borings will help confirm or deny the extent of contamination. Two of the borings are located directly downgradient of this potential plume.

- The site lies on a topographic high which slopes to the north towards a creek that leaves the base. Ground-water samples will indicate whether contamination is leaving the vicinity via the ground water. The third boring is located to verify the ground-water flow direction for the western side of this topographic "high".

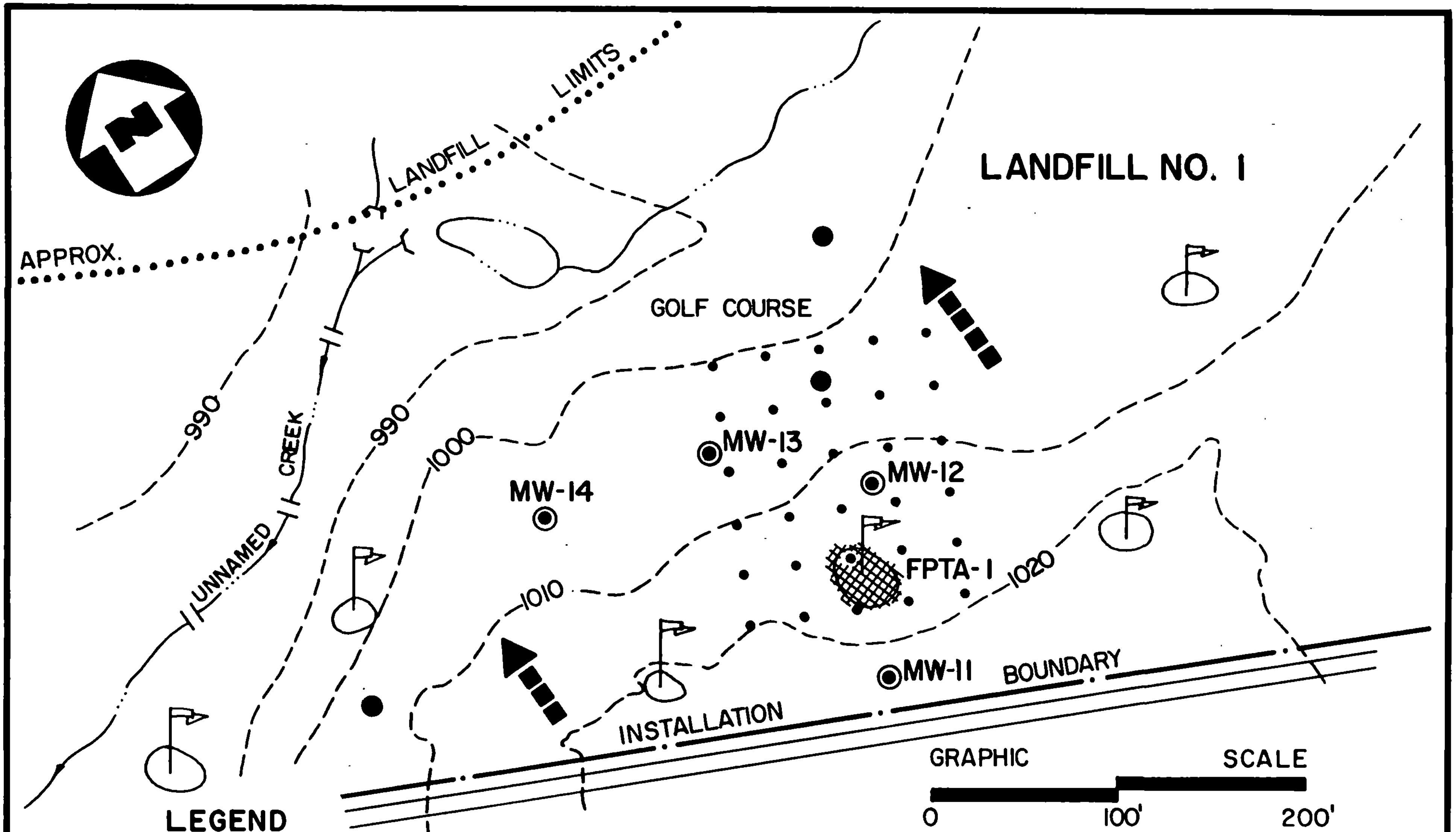
- FPTA-1 lies in an area of the base which contains an abundance of irregular sands that may act as conduits for the movement of contaminants. The additional borings will aid in the characterization of these potential contaminant pathways.

- Since a variety of fuels, waste oils, and solvents were burned or emptied at the site, both "sinking" and "floating" contaminants may be present in the ground water.

Monitoring Wells

NUS will install three monitoring wells at the locations shown on Figure 4-5. The exact locations of the monitoring wells will be refined in the field, as necessary. The three wells will be installed to a total depth of about 30 feet (depending on the depth to ground water) with a 15-foot screened interval across the saturated zone. The 15-foot screened interval is necessary due to large fluctuations in ground water documented in adjacent monitoring wells.

The locations of the three monitoring wells have been selected in an attempt to establish two downgradient and one along-gradient well. A continuous core of the subsurface material will be collected from the first of the three borings. In subsequent borings, cuttings will be continuously logged and split-spoon samples will be collected at 5-foot intervals or at changes in pedology, as directed by NUS. These data will be used to interpret geologic and hydrogeologic conditions at the site. A maximum of three subsurface-soil samples per well will be preserved for laboratory analyses. All soil samples will be screened in the field, using a PID instrument. Alternatively, additional samples may be submitted for laboratory analyses if the results of the field screening indicate that additional depth interval should be investigated for contaminants.



LEGEND

GENERAL DIRECTION OF GROUND-WATER FLOW

PROPOSED SOV LOCATION

EXISTING MONITORING WELL

PROPOSED BORING

FIGURE 4-5 SAMPLING LOCATIONS AT FPTA-1 SITE
GROUND-WATER FLOW DIRECTION DERIVED FROM PHASE II REPORT

NUS CORPORATION

Environmental Sampling

Following well installation and development, a sampling team will collect ground-water samples from the three monitoring wells at the FPTA-1 site. Sampling of existing monitoring wells MW-11 through MW-14 will be performed. Surface-soil, surface-water, and sediment samples collected for LF-1 are located to also address FPTA-1.

Sample Analyses

Based on previous sample analyses contained in the Phase II Report and the historical use of the site, where waste fuels and oils were harbored and burned routinely, all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables and, TCL PCBs. Additionally, one soil sample will be analyzed for cation exchange capacity, while ground-water samples will be analyzed for pH, common anions, and TDS because FPTA-1 lies within LF-1. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-8.

4.7 FIRE PROTECTION TRAINING AREA 2 (FPTA-2)

FPTA-2 is located within the runway area of the base between Taxiway C and Taxiway D. Fuels, solvents, and contaminated oil were burned at the site. There is the potential for shallow ground water at this site. The burn pit was a concrete-lined structure which is still present, as are parts of the oil-water separator system. The site slopes gently to the north and east towards an ephemeral stream and a concrete-lined ditch, which join near the site and exit the base by a culvert.

The initial activity at the site will be the installation of a monitoring well, if ground water is encountered. A subsurface-soil sample will be collected for the well boring. Near surface-soil samples (2-5 feet below the ground surface) will be obtained by pushing Shelby tubes. Four Shelby tube samples will be collected around the pit to a depth of about 5 feet. A sampling team will then sample ground water from the well, if installed. Analytical results of the soil and ground-water samples will be used to assess the presence or absence of target contaminants at the site and to provide preliminary information on their spatial distribution.

TABLE 4-8

FPTA-1 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	7/--	7
13 Priority Pollutant Metals	EPA Methods	C	7/--	7
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	7/--	7
PCBs (TCL)	CLP	D	7/--	7
Total Dissolved Solids (TDS)	EPA 160.1	C	7/--	7
Chloride	SM 407B	C	7/--	7
Fluoride	SM 413B	C	7/--	7
Bromide	EPA 320.1	C	7/--	7
Nitrate	EPA 352.1	C	7/--	7
Phosphate	EPA 365.2	C	7/--	7
Sulfate	SM 426C	C	7/--	7

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	--	9	--	9
13 Priority Pollutant Metals	EPA Methods	C	--	9	--	9
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	--	9	--	9
PCBs (TCL)	CLP	D	--	9	--	9
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

The rationale for the proposed near surface-soil samples and boring/monitoring well is based on the following:

- The boring/monitoring well is located generally downgradient of the original burn pit and may be located near any former contaminant pond.

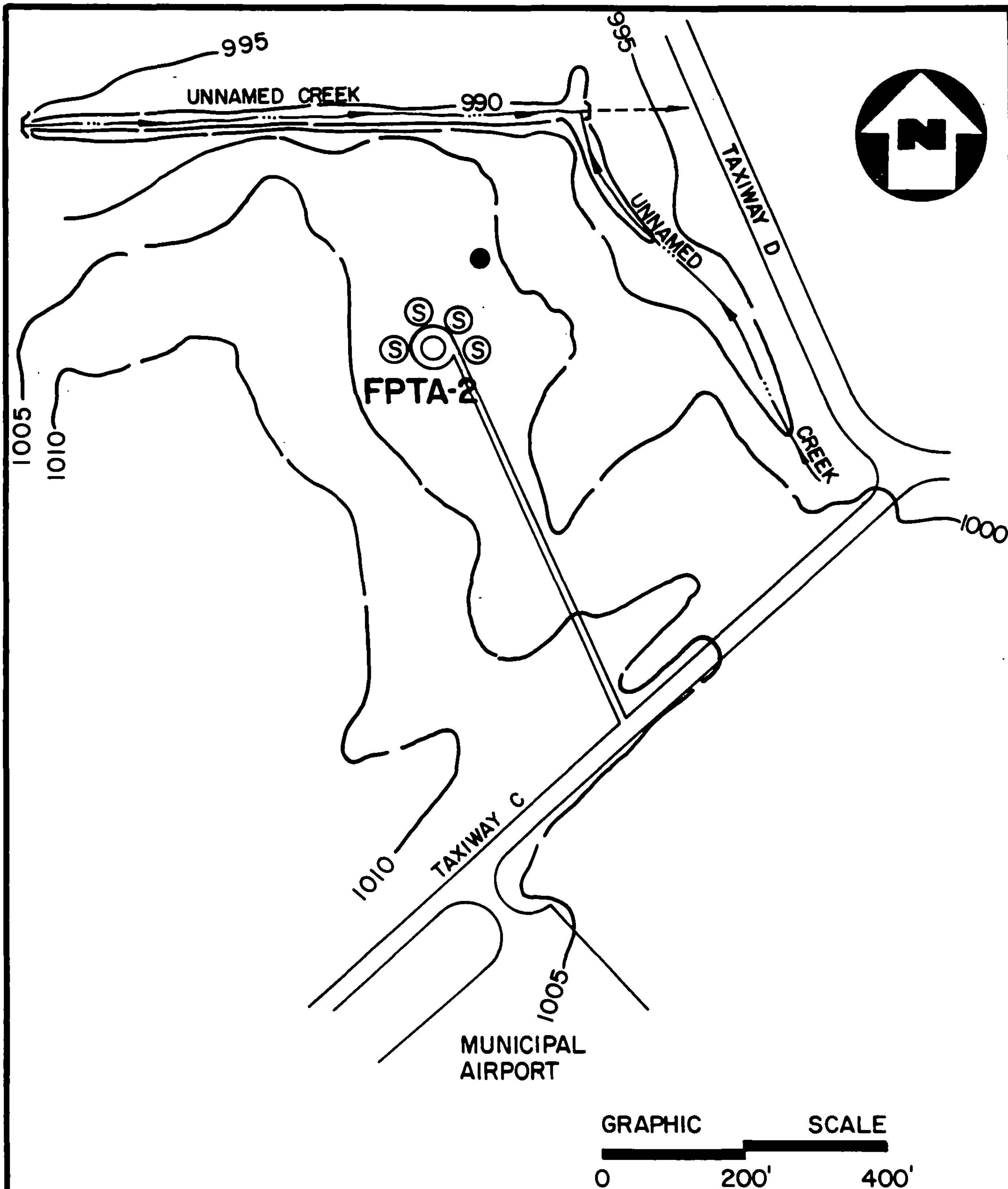
- Since a variety of fuels, solvents, and contaminated oils were burned at the site, the potential for both "floating" and "sinking" contaminants exists at FPTA-2.

- There is no surface or subsurface information in the area of FPTA-2. Such information is necessary to define potential contaminant pathways in the subsurface.

Monitoring Wells

NUS will install one monitoring well generally downgradient of the site, as indicated in Figure 4-6. The exact locations of the monitoring well will be refined in the field. The well will be installed to a total depth of approximately 30 feet (or greater depending on the depth to ground water) with a 10-foot screen interval open across the water table. If ground water is not encountered the boring will be advanced to a maximum depth of 50 feet.

The location of the monitoring well has been selected in an attempt to have one topographically downgradient well. Two optional wells have been reserved for this site (see Section 4.14). Auger cuttings for these wells will be continuously logged and split-spoon samples will be collected at 5-foot intervals, or at changes in pedology, as directed by NUS. The initial boring will be continuously cored. These data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of one subsurface-soil sample will be preserved for laboratory analyses. All soil samples will be screened in the field using a PID instrument. Alternatively, additional soil samples may be submitted for laboratory analyses if the results of the field screening indicate that more than one depth interval should be investigated for contaminants.



LEGEND

PROPOSED SURFACE SOIL Ⓢ

PROPOSED BORING ●

FIGURE 4-6 SAMPLING LOCATIONS AT FPTA-2 SITE

NUS CORPORATION

Environmental Sampling

In conjunction with drilling activities, NUS will collect four near surface-soil samples by utilizing the drilling equipment to obtain samples. Specifically, the drill rig will be utilized to push Shelby tube samples at the surface. Following well installation, a sampling team will collect a ground-water sample from the monitoring well at the site.

Sample Analyses

Based on the historical use of this site as an area where waste fuel and oils were harbored and burned routinely, all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. Additionally, one soil sample will be analyzed for cation exchange. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-9.

4.8 FIRE PROTECTION TRAINING AREA 3 (FPTA-3)

FPTA-3 is located along Bridwell Road, adjacent to the corner of the old municipal runway. The site has been in continuous use since 1957. Waste fuel has been the primary material used for training exercises at this FPTA. A fuel drainage, collection, and separation system was installed in 1982. Prior to that time, no such system was used at the site. An obvious fuel odor was detected during a recent site visit. The surface soil appears discolored within and near the evaporation pond.

FPTA-3 was subject to a subsurface investigation as part of the Phase II investigation. This study identified sandy and clayey soils beneath the site. In addition, inorganic and organic contamination was substantiated at the site by laboratory analyses.

Three monitoring wells were installed around the site during the Phase II investigation. Unfortunately, these wells were screened only at the depth covering the interval where ground water was first encountered. The static water level, however, ranges from 13 to 19 feet above the top of the screened interval. Since

TABLE 4-9

FPTA-2 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	1/--	1
13 Priority Pollutant Metals	EPA Methods	C	1/--	1
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1/--	1
PCBs (TCL)	CLP	D	1/--	1

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	4	1	--	5
13 Priority Pollutant Metals	EPA Methods	C	4	1	--	5
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	4	1	--	5
Pesticides/PCBs (TCL)	CLP	D	4	1	--	5
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

many of the contaminants of primary concern at this site are fuels, which are typically "floaters," these wells may be ineffective for sampling for these types of contaminants.

The initial activity at the site will be a soil organic vapor (SOV) survey followed by the installation of a monitoring well. The boring for this monitoring well will be continuously cored. Subsurface-soil samples will be collected from the well boring and preserved for laboratory analyses by NUS. Subsequently, a sampling team will sample ground water from the monitoring wells at the site. Analytical results of all soil and ground-water samples will be used to determine the extent and nature of target contaminants at the site.

The rationale for the proposed monitoring well and environmental samples is as follows:

- Since volatile hydrocarbons are the contaminants of primary concern, the SOV survey should effectively detect any contaminated soil gas in the shallow subsurface.

- Since waste fuel is primarily used for the training exercises, "floating" contaminants are of the largest concern. However, since records of the burn material are sketchy and the site has been in use for over 30 years, "sinkers" may also be present.

- The existing monitoring wells are not constructed to effectively allow for the detection of floating hydrocarbons. The added well will be constructed, so that these contaminants can freely enter the screened interval. Fifteen-foot screens are deemed necessary, due to large fluctuations in ground water documented in adjacent wells.

- The use of continuous coring for the new well will provide more complete data on the extent of the sandy units found in the subsurface beneath the site in the Phase II investigation. The well is located in a downgradient position, to properly intercept any contaminants moving with the ground water.

Soil Organic Vapor Survey

NUS will conduct an SOV survey at the site at the locations shown on Figure 4-7. The exact locations of the probe holes will be refined in the field as necessary. Initially, several probe holes will be driven to ascertain the feasibility of the SOV survey in this geologic environment. If air samples cannot be extracted from the soils, the SOV survey will be terminated. Approximately 30 probe locations will be driven or augered to a depth not to exceed 5 feet. The location of the sampling grid is generally downgradient of the site.

Soil gas samples will be collected from the boreholes by an air pump and sampling device. The samples will be analyzed for VOC using a Photovac 10S50 portable photoionization GC.

Monitoring Wells

NUS will install one monitoring well downgradient of the site, as indicated in Figure 4-7. The exact locations of the monitoring well will be refined in the field, as necessary. The well will be installed to a total depth of approximately 30 feet, with a 15-foot screen interval open across the water table.

The location of the monitoring well has been selected in an attempt to have a downgradient well with a properly screened interval. The borehole data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of three subsurface-soil samples will be collected from the boring to assess the vertical extent of contamination at the site. All soil samples will be screened in the field, using a PID instrument. Alternatively, more than three soil samples may be submitted for laboratory analyses, if the results of the field screening indicate that additional depth intervals should be investigated for contaminants. Three optional monitoring wells are reserved for this site (see Section 4.14).

Environmental Sampling

Following well installation and development, a sampling team will collect groundwater samples from each of the monitoring wells (i.e., a total of four samples) at the FPTA-3 site (see Figure 4-7).

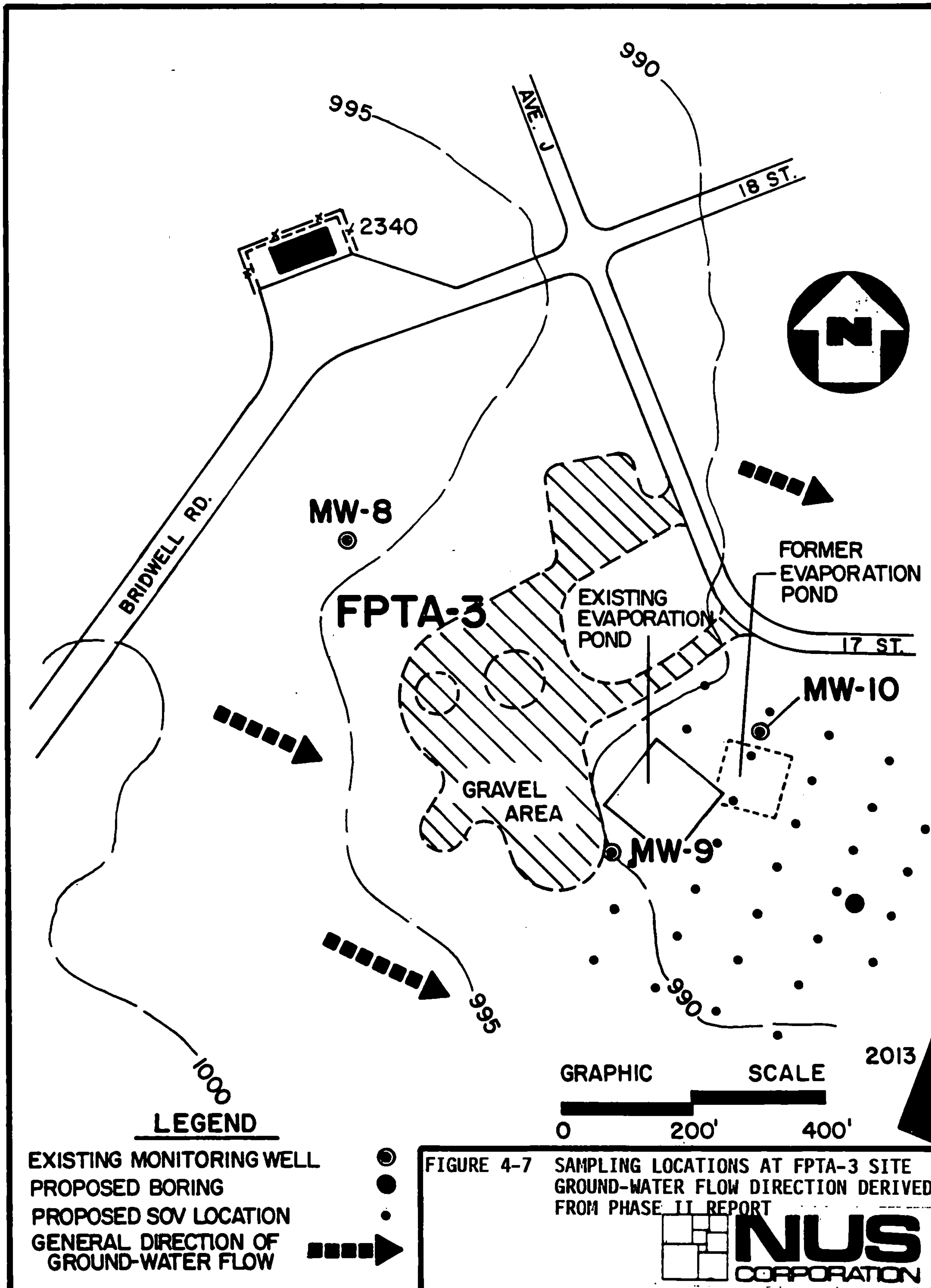


FIGURE 4-7 SAMPLING LOCATIONS AT FPTA-3 SITE
GROUND-WATER FLOW DIRECTION DERIVED
FROM PHASE II REPORT

NUS CORPORATION

Sample Analyses

Based on previous sample analyses contained in the Phase II report and the historical use of this site as an area where waste fuel and oils were harbored and burned routinely, all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. Additionally, one soil sample will be analyzed for cation exchange capacity. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-10.

4.9 INDUSTRIAL WASTE PIT (WP-2)

The Industrial Waste Pit was an earthen structure used during the 1950s as a storage impoundment for waste oils and fuels from old engine test cells. On several occasions, the wastes were burned. There is no surficial evidence of the waste pit presently, except for a small concrete-lined pond at the eastern corner of the site. The pond is fed by a concrete pipe, which may be the Industrial Waste Line referred to in the Phase I Record Search investigation. The pond empties into a culvert, then discharges into the unnamed creek that flows through the golf course and off the base. Presently, a portion of the site is used as a driving range for the base golf course.

The initial activity at the site will be a thorough records search of existing aerial photographs and documents to ascertain the original limits of the waste pits. This activity may be followed by the installation of two borings to be completed as monitoring wells, if ground water is encountered. Subsurface soil samples will be collected during the drilling of the well borings and preserved for laboratory analyses. Subsequently, a sampling team will sample surface-soil and ground water from each installed monitoring well. Analytical results of the soil and ground-water samples will be used to assess the presence or absence of target contaminants at the site and to provide preliminary information on their spatial distribution.

TABLE 4-10

FPTA-3 LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	4/--	4
13 Priority Pollutant Metals	EPA Methods	C	4/--	4
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	4/--	4
PCBs (TCL)	CLP	D	4/--	4

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	--	3	--	3
13 Priority Pollutant Metals	EPA Methods	C	--	3	--	3
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	--	3	--	3
PCBs (TCL)	CLP	D	--	3	--	3
Cation Exchange Capacity	SW 9081	C	C	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

The rationale for the records search, optional monitoring wells and environmental samples is based on the following:

- The records search is required to verify the proper location needed to conduct a field investigation.

- The site was used as impoundment for waste oils and fuels from old engine test cells. Therefore, the primary contaminants are "floaters", although "sinkers" may also be present. Monitoring wells screened across the water table are necessary to intercept these contaminants.

- Ground water at this site could possibly contaminate the unnamed creek, providing the ground water is in hydraulic connection with the creek. The well boring will aid in this determination.

- A surface-soil sample is necessary to assess the presence or absence of contamination, which may present a public health hazard resulting from either direct contact or offsite dispersion of contaminants from the surface of WP-2.

Monitoring Wells (Optional)

NUS will install two monitoring wells at the WP-2 site. The exact locations will be refined by the records search and in the field. The wells will be augered to a depth of approximately 50 feet; however, they will be terminated 10 feet below the first appearance of ground water. The monitoring wells will be screened 10 feet across the water table.

The location of the monitoring wells will be selected in an attempt to have at least one topographically downgradient well. During boring of the wells, cuttings will be continuously logged and split-spoon samples will be collected at 5-foot intervals, or at changes in pedology, as directed by NUS. At least one continuous core of the soil will be collected. These data will be used to interpret geologic and hydrogeologic conditions at the site. A minimum of one soil sample from each boring will be preserved for laboratory analyses. All samples will be screened in the field, using a PID device. Alternatively, an additional sample may be submitted for laboratory analyses, if the screening results indicate that contamination should be investigated at several depth intervals.

Environmental Sampling (Optional)

Following well installation, a sampling team will collect ground-water samples at the WP-2 site from the monitoring wells. A surface-soil sample will be collected within the area of the original waste pit (see Figure 4-8).

Sample Analyses (Optional)

Based on the historical use of this site, as an area where waste oil and fuels were harbored, all samples will be analyzed for TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, and TCL PCBs. Additionally, one soil sample will be analyzed for cation exchange capacity. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-11.

4.10 PESTICIDE SPRAY AREA (PSA)

Rinse water generated from cleaning pesticide containers and pesticide application equipment is allowed to infiltrate the gravel lot adjacent to the Entomology Shop at Building 4493. This practice has been ongoing for about 40 years. The rinse water is directed towards a drain, which leads to a culvert that discharges into the Sewage Treatment Plant.

The initial activity at this site will be the collection of surface-soil samples, by utilizing the drill rig to push Shelby tube samples for laboratory analyses. Analytical results of the soil samples will be used to assess the presence or absence of target contaminants at the site and to provide preliminary information on their spatial distribution.

The rationale for the proposed soil samples is as follows:

- Since the only contaminants of concern at the PSA site are pesticides and herbicides, which are relatively immobile compounds, there is little risk of deeper subsurface contamination.

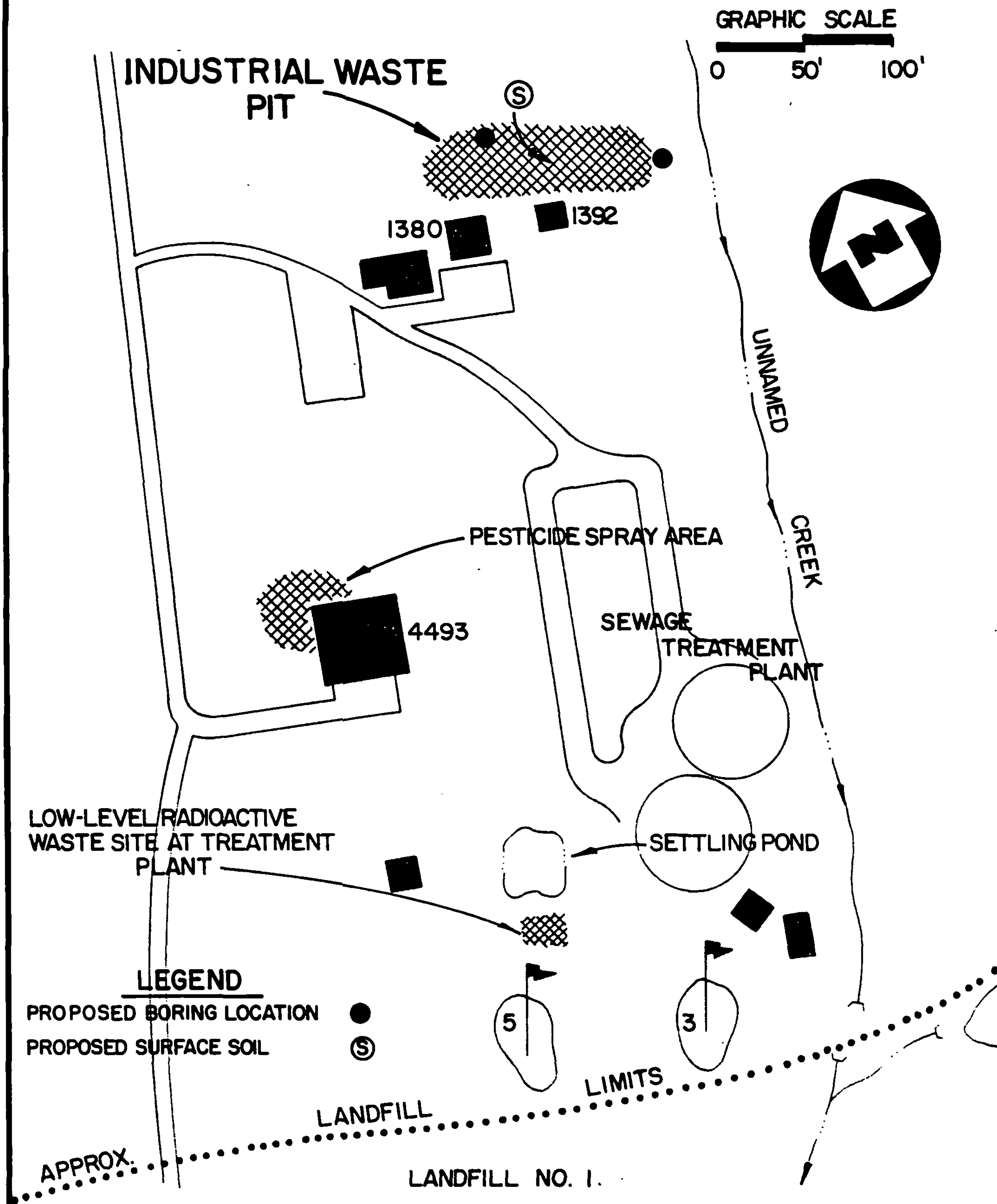


FIGURE 4-8 SAMPLING LOCATIONS AT WP-2 SITE

NUS CORPORATION

TABLE 4-11

WP-2 LABORATORY ANALYTES[a] (OPTIONAL)
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	2/--	2
13 Priority Pollutant Metals	EPA Methods	C	2/--	2
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	2/--	2
PCBs (TCL)	CLP	D	2/--	2

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	1	2	--	3
13 Priority Pollutant Metals	EPA Methods	D	1	2	--	3
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1	2	--	3
PCBs (TCL)	CLP	D	1	2	--	3
Cation Exchange Capacity	SW 9081	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water

- Surface-soil samples are necessary to evaluate potential public health hazards resulting from either direct contact or offsite dispersion of contaminants from the surface of the site.

- Two soil samples from each location, taken at a depth of 0 to 5 feet, are proposed to discern the presence of contamination.

Environmental Sampling

The four soil samples will be collected by NUS through the use of a drill rig to collect Shelby tube samples. A sample will be collected from each small boring from a depth ranging from 0 to 5 feet. The sample locations are generally shown on Figure 4-9. The exact locations will be discerned in the field by NUS.

Sample Analyses

All soil samples will be screened in the field by the sampling team. Screening will be conducted using a PID instrument. All instrument readings will be noted on the sampler's logbook.

Two soil samples from each shallow boring will be collected and preserved for analyses.

Based on the historical use of this site as an area where pesticide equipment, containers, and other materials were washed, all samples will be analyzed for TCL pesticides, organophosphorus pesticides, and chlorinated herbicides. A complete accounting of specific sample numbers, analytical methods, and QA/QC sampling is summarized in Table 4-12.

4.11 LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE (LLRW-1)

LLRW-1 is located immediately south of a settling pond associated with the sewage treatment facility (see Figure 4-9). The site is approximately a 10 by 10-foot grassed area surrounded by a locked chain link fence. Beneath the grassed area is a reported 6-inch diameter, concrete-lined well about 14 feet deep. There is no written evidence of the site's use.

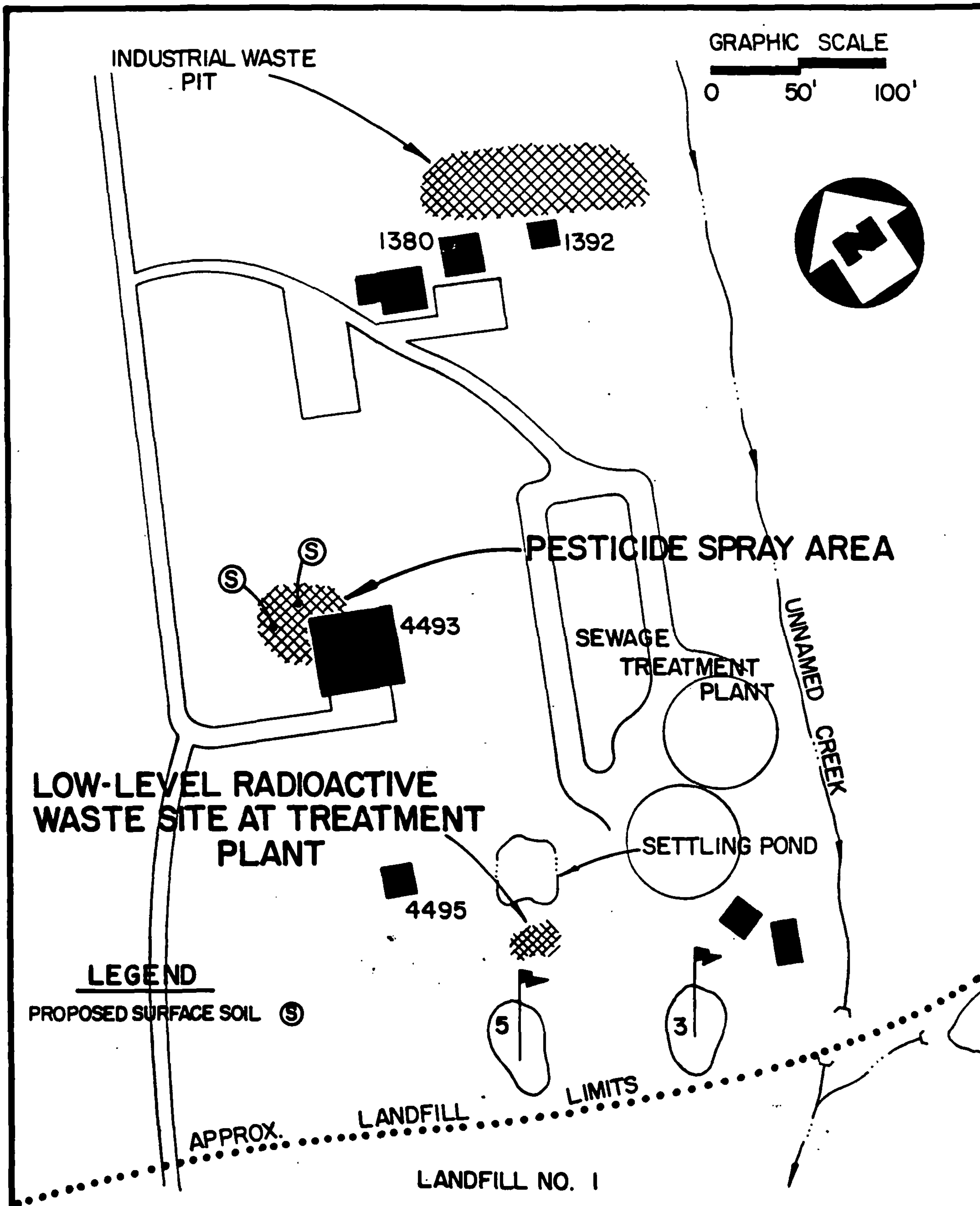


FIGURE 4-9 SAMPLING LOCATIONS AT PSA AND LLRW-1 SITE

NUS CORPORATION

TABLE 4-12

PSA LABORATORY ANALYTES[a]
SHEPPARD AIR FORCE BASE

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
Pesticides (TCL)	CLP	D	4	--	--	4
Organophosphorus Pesticides	SW8140	D	4	--	--	4
Chlorinated Herbicides	SW8150	D	4	--	--	4

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.

The initial activity at the site is to attempt to locate the well top by excavating the ground surface with a shovel. If hand excavation proves inadequate, a backhoe will be utilized for this task. If the well is still open and intact, the hole will be screened with a Geiger-Mueller (GM) device. As an option, a boring will be drilled adjacent to and downgradient of LLRW-1. It will be completed as a monitoring well, if ground water is encountered.

The rationale for the optional proposed boring/monitoring well is that it will provide assurance that contamination has or has not migrated out of the well. If a monitoring well is installed, it will aid in deciding whether or not the ground water has been contaminated.

Sample Analyses (Optional)

If a boring is constructed at this site, sample analyses will be conducted as summarized in Table 4-13.

4.12 LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE IN LANDFILL 3 (LLRW-2)

LLRW-2 is a marked area, approximately 525-square feet within LF-3, which contains a buried vault possibly containing radioactive material (see Figure 4-4). No written records of the site's use are available. The site is located near, and partially within the flood plain of, a small unnamed creek which eventually joins Bear Creek.

The initial activity at the site will be a geophysical survey of the marked area, so that the buried vault may be located. Magnetometry and electromagnetic (EM) terrain conductivity geophysical techniques will be used. Since there is no record of the location of the buried vault within the marked area, the geophysical survey is necessary to find its location and any other foreign objects which may prove an obstacle to drilling.

Upon identification of the vault, an optional boring will be drilled near the site, which will be completed as a monitoring well if ground water is encountered. Analytical results of the soil and ground-water samples will be used to determine the presence or absence of target contaminants at the site and to provide preliminary information on their spatial distribution.

TABLE 4-13

LLRW-1 LABORATORY ANALYTES[a] (OPTIONAL)
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
Gross Alpha, Gross Beta	SW 3550/ EPA 900.0	C	1/--	1
Radium-226[d]	EPA 903.0	C	1/--	1
Radium-228[d]	EPA 904.0	C	1/--	1
Gamma Spectrometry	EPA MSL	C	1/--	1
Lead	EPA 239.2	D	1/--	1

MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
Gamma Spectrometry	EPA 905.0	C	--	1	--	1
Lead	SW7420	D	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water
d Evaluation of the isotopes of radium will be performed only if Gross Alpha and Gross Beta results exceed Federal Safe Drinking Water Act (SDWA) MCLs.

The rationale for the optional monitoring well is as follows:

- The boring/monitoring well will aid in discerning whether or not contamination is present and has spread into the ground water or subsurface soil.

- The boring will allow the subsurface to be screened for radioactivity without having to remove the burial vault.

Sample Analyses (Optional)

If a boring is completed on the site, sample analyses will be conducted as summarized in Table 4-14. Due to the location of LLRW-3, the laboratory analytes for LF-3 have been included as part of the analyses.

4.13 BASE BACKGROUND (BB) SAMPLE ANALYSES

One well boring will be located in appropriate areas to reflect background levels of radiological and risk-assessable contaminants. Based on hydrogeologic considerations, the well will be positioned as a non-receptor of potential contaminants from the 11 sites under investigation. Locations of this well boring will be determined in the field.

In order to provide a base standard with which the analytical data can be compared, base background samples will be collected from a soil boring located on the base. The surface- and subsurface-soil samples will be screened in the field by the sampling team. Screening will be conducted using a PID and GM device. Instrument reading will be noted on the well boring log or sampler's logbook, as appropriate.

The well boring will serve as a source of one surface-soil and two subsurface-soil samples, which will be preserved for determination of background levels of TCL volatile organics, 13 priority pollutant metals, priority pollutant BN/A extractables, TCL pesticides/PCBs, and gamma radiation. The ground water sampled in this well

TABLE 4-14

LLRW-2 LABORATORY ANALYTES[a] (OPTIONAL)
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	1/--	1
13 Priority Pollutant Metals	EPA Methods	D	1/--	1
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1/--	1
PCBs (TCL)	CLP	D	1/--	1
Total Dissolved Solids (TDS)	EPA 160.1	C	1/--	1
Chloride	SM 407B	C	1/--	1
Fluoride	SM 413B	C	1/--	1
Bromide	EPA 320.1	C	1/--	1
Nitrate	EPA 352.1	C	1/--	1
Phosphate	EPA 365.1	C	1/--	1
Sulfate	SM 426C	C	1/--	1
Gross Alpha, Gross Beta	SW 3550/A703	C	1/--	1
Radium-226[d]	EPA 903.0	C	1/--	1
Radium-228[d]	EPA 904.0	C	1/--	1
Gamma Spectrometry	EPA MSL	C	1/--	1
Cyanide	EPA 335.2	C	1/--	1

TABLE 4-14 (CONTINUED)

LLRW-2 - LABORATORY ANALYTES (OPTIONAL)
SHEPPARD AIR FORCE BASE
MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total[d]
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	--	1	--	1
13 Priority Pollutant Metals	EPA Methods	D	--	1	--	1
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	--	1	--	1
PCBs (TCL)	CLP	D	--	1	--	1
Cation Exchange Capacity	SW 9081	C	--	1	--	1
Gamma Spectrometry	EPA 905.0	C	--	1	--	1

a Table provides number of environmental samples (i.e., does not include QA samples).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water
d Evaluation of the isotopes of radium will be performed only if Gross Alpha and Gross Beta results exceed Federal Safe Drinking Water Act (SDWA) MCLs.

will be preserved and analyzed for TCL volatile organics, priority pollutant BN/A extractables, 13 priority pollutant metals, TCL pesticides/PCBs, common anions, TDS, cyanide, pH, and the following radiological parameters:

- Gross alpha and gross beta
- Radium-226
- Radium-228
- Gamma spectrometry

A complete accounting of specific sample numbers, analytical methods, and QA/QC samples is summarized in Table 4-15.

4.14 OPTIONAL BORINGS/MONITORING WELLS

Twenty optional borings are proposed at Sheppard AFB to allow the field geologist the ability to gain additional subsurface information in response to field conditions. These borings will be completed as monitoring wells, if ground water is encountered. Installation of the optional borings will not occur until written approval is given by the HAZWRAP Project Manager. The analytical program for each boring will follow the site-specific plans previously mentioned in Sections 4.2 through 4.13.

The number of optional borings is based upon the following rationale:

- Three optional borings are proposed at WP-1. This option will be exercised if the decision document is not approved by the state regulatory agency.

- Two optional borings are proposed for LF-1. These borings may be necessary to determine ground-water flow and/or better define the extent of contamination.

- Two optional borings are proposed for LF-2. These borings may be necessary, if ground water is encountered, to determine the direction of ground-water flow. These borings will also better define the extent of contamination.

TABLE 4-15

BACKGROUND SAMPLES[a]
SHEPPARD AIR FORCE BASE

MATRIX: GROUND WATER/SURFACE WATER

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Total Number of Environmental Samples GW/SW[c]	Total
TCL Volatile Organics	CLP (without TICs)	D	1/--	1
13 Priority Pollutant Metals	EPA Methods	C	1/--	1
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1/--	1
Pesticides/PCBs (TCL)	CLP	D	1/--	1
Total Dissolved Solids (TDS)	EPA 160.1	C	1/--	1
Chloride	SM 407B	C	1/--	1
Fluoride	SM 413B	C	1/--	1
Bromide	EPA 320.1	C	1/--	1
Nitrate	EPA 352.1	C	1/--	1
Phosphate	EPA 365.2	C	1/--	1
Sulfate	SM 426C	C	1/--	1
Gross Alpha, Gross Beta	SW 3550/A703	C	1/--	1
Radium-226[d]	EPA 903.0	C	1/--	1
Radium-228[d]	EPA 904.0	C	1/--	1
Gamma Spectrometry	EPA MSL	C	1/--	1
Cyanide	EPA 335.2	C	1/--	1

TABLE 4-15 (CONTINUED)

BACKGROUND SAMPLES
SHEPPARD AIR FORCE BASE
MATRIX: SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT

Parameter	Analytical Methods[b]	Air Force QA/QC Level[b]	Type and Number of Environmental Soil Samples			Total
			Surface	Soil Boring	Sediment	
TCL Volatile Organics	CLP (without TICs)	D	1	2	--	3
13 Priority Pollutant Metals	EPA Methods	D	1	2	--	3
Priority Pollutant BN/A Extractables	CLP (without TICs)	D	1	2	--	3
Pesticides/PCBs (TCL)	CLP	D	1	2	--	3
Gamma Spectrometry	EPA 905.0	C	1	2	--	3

a Table provides number of environmental samples (i.e., does not include QA samples or optional work).
b Analytical methods and QA/QC levels are defined in Appendix B.
c GW = ground water
SW = surface water
d Evaluation of the isotopes of radium will be performed only if Gross Alpha and Gross Beta results exceed Federal Safe Drinking Water Act (SDWA) MCLs.

- Three optional borings are proposed for LF-3. These borings may be required if ground water is encountered and/or if additional information is needed to define the extent of contamination.

- Two optional borings are proposed for WP-2. These borings will be necessary if the records search reveals the original location of the site.

- One optional boring is proposed at LLRW-1. This boring will be constructed if ground water is discovered within the disposal well on the site.

- Two optional borings are proposed for FPTA-2. These well borings will be requested if contamination is substantiated by the four surface-soil samples or the soil boring.

- Three optional borings are proposed at FPTA-3. These borings will be required if a contaminant plume is confirmed to be present at the site or if the SOV survey does not function in the existing soil conditions.

- One optional boring is proposed for LLRW-2. This boring will be required if the buried vault is identified during the geophysical survey.

- One optional boring is proposed as a base background point. This boring will be required if contamination is found in the first boring or if ground water is not encountered.

Optional borings not used as presently designated, may be installed at any other site, based upon field conditions and approval granted by the HAZWRAP Project Manager.

Table 4-16 presents the number of optional samples for laboratory analysis (by site and matrix).

TABLE 4-16

NUMBER OF OPTIONAL SAMPLES FOR LABORATORY ANALYSIS (BY SITE AND MATRIX) SHEPPARD AFB

Site	Soil			Water	
	Surface[a]	Subsurface	Sediment	Ground	Surface
WP-1	1	9	1	3	1
LF-1	1	6	--	2	--
LF-2	--	6	--	2	--
LF-3	2	9	--	3	--
FPTA-1	--	--	--	--	--
FPTA-2	--	4	--	2	--
FPTA-3	--	6	--	3	--
WP-2	2	2	--	2	--
PSA	2	--	--	--	--
LLRW-1	--	1	--	1	--
LLRW-2	--	1	--	1	--
Base Background	--	2	--	1	--
Total	8	46	1	20	1

a "Surface" soil is defined as soil obtained at a depth of 0-3' below grade.

5

5.0 SCHEDULE

The proposed schedule for performing the RI tasks at Sheppard AFB is presented in Figure 5-1.

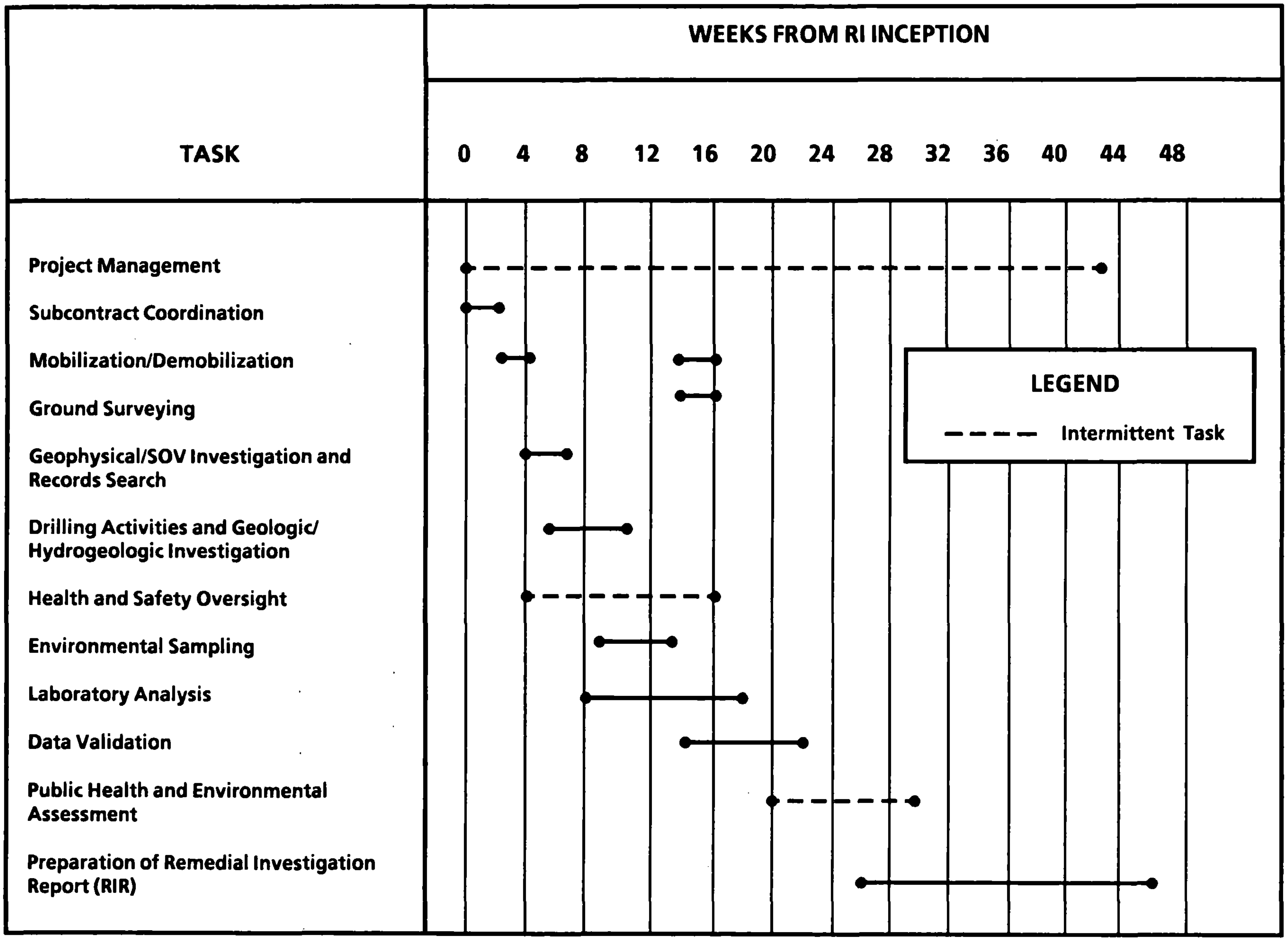


FIGURE 5-1

REMEDIAL INVESTIGATION SCHEDULE
SHEPPARD AFB

APPENDICES

A

APPENDIX A

HEALTH AND SAFETY PLAN

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)

ELEVEN SITES AT SHEPPARD AFB
WICHITA FALLS, TEXAS

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TABLES

FIGURES

ATTACHMENTS

A.1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide safety procedures for NUS employees and NUS subcontractor personnel engaged in field activities at Sheppard Air Force Base (AFB). This plan was developed using limited available information regarding possible chemical contaminants and physical hazards that may be encountered during the planned investigatory activities. If additional information becomes available prior to or during the course of field activities, this document will be modified accordingly. Modifications will be determined by the Project Health and Safety Officer (HSO), with the NUS Project Manager communicating major health and safety plan modifications (e.g., a need for a change in the level of protection) to appropriate Martin Marietta Energy Systems, Inc. (HAZWRAP) and United States Air Force (USAF) personnel. This HASP and the NUS-designated health and safety protocols have been developed to protect the health and safety of involved personnel and the environment as well as to comply with OSHA Standard 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response; Interim Final Rule."

The Project Field Team for Sheppard Air Force Base includes

NUS Project Manager	D. W. Hodson
NUS Project Health and Safety Officer (HSO)	K. A. Kenney
NUS Field Coordinator/Alternate HSO	J. E. Wedekind
NUS Geophysicist	P. J. Jones
NUS Sampling Team Leader	R. L. Knight
NUS Site Geologists	(To be determined)
NUS Sampling Technicians	(To be determined)
Drilling/Surveying Subcontractors	(To be determined)

The Project HSO will be involved with startup activities, i.e., subcontractor training and initial health and safety oversight. When this person is not present on site, the alternate HSO will assume the designated health and safety responsibilities in addition to his/her other on site duties.

A.2.0 BACKGROUND INFORMATION

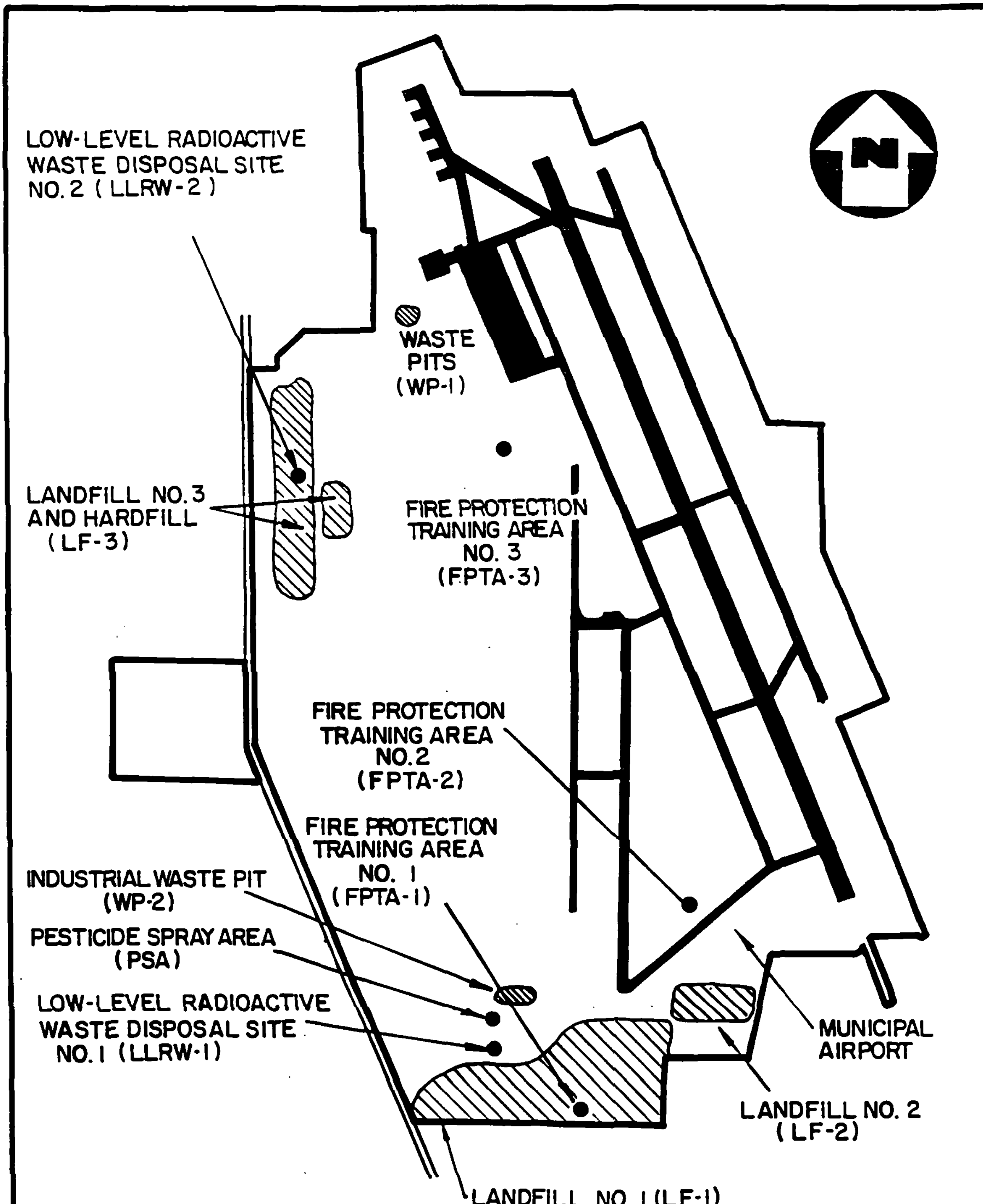
Sheppard AFB is located in Wichita County, Texas, 4 miles north of Wichita Falls and 150 miles northwest of Dallas. The surrounding area is semirural. The main installation comprises 5,249 acres in area.

Sheppard Field was activated in October 1941, on a 300-acre site. During World War II, basic training schools in several subject areas were conducted at Sheppard Field. The base was deactivated in August 1946. It was then reactivated in August 1948. During this period of inactivity, the facilities on base were not used. In 1949, the Airplane and Engine Mechanics School was transferred to Sheppard AFB. This school is now part of the USAF School of Applied Aerospace Sciences (SAAS). In 1958, the 494th Bombardment Wing, Strategic Air Command, was activated as a tenant unit. This unit, composed of B-52 and KC-135 aircraft, remained at Sheppard until 1966. In October 1965, the 3637th Flying Training Squadron (Helicopter) was activated at Sheppard as a part of what is now the 80th Flying Training Wing (FTW). The 80th FTW presently conducts pilot training for 12 nations in T-37 and T-38 aircraft as part of the Euro-Nato Joint Pilot Training (ENJPT) Program. The 3790 Medical Service Training Wing conducts basic and advanced training in medial specialities and orientation of newly commissioned medical officers.

Eleven sites have been designated for field investigatory activities; these sites are discussed individually in the following subsections. The location of each site on base can be seen in Figure A-1. Regional and area location maps are provided as Figures A-2 and A-3, respectively.

<u>Waste Pits</u>

In 1966, three waste pits were excavated to contain waste engine cleaning fluids and solvents from nearby maintenance buildings. These pits were along Avenue H, across from Building 2325 (see Figure 4-1), and within the floodplain of Bear Creek. The pits were approximately 80 feet square, 10 feet deep, and unlined. On one occasion in the late 1960s, an adjacent storm pond overflowed and carried some of the waste pit contents into the storm water system and, hence, into Plum Creek. The pits were actively used from 1966 to the mid-1970s. The boundaries of WP-1 are undefined, since the pits were "scraped away" when they had outlived their usefulness.



SHEPPARD AIR FORCE BASE
SITE PLAN
NOT TO SCALE

FIGURE A-1 SHEPPARD AIR FORCE BASE SITE PLAN
SOURCE: PHASE I - RECORDS SEARCH
FEBRUARY, 1984

NUS CORPORATION

SHEPPARD AIR FORCE BASE

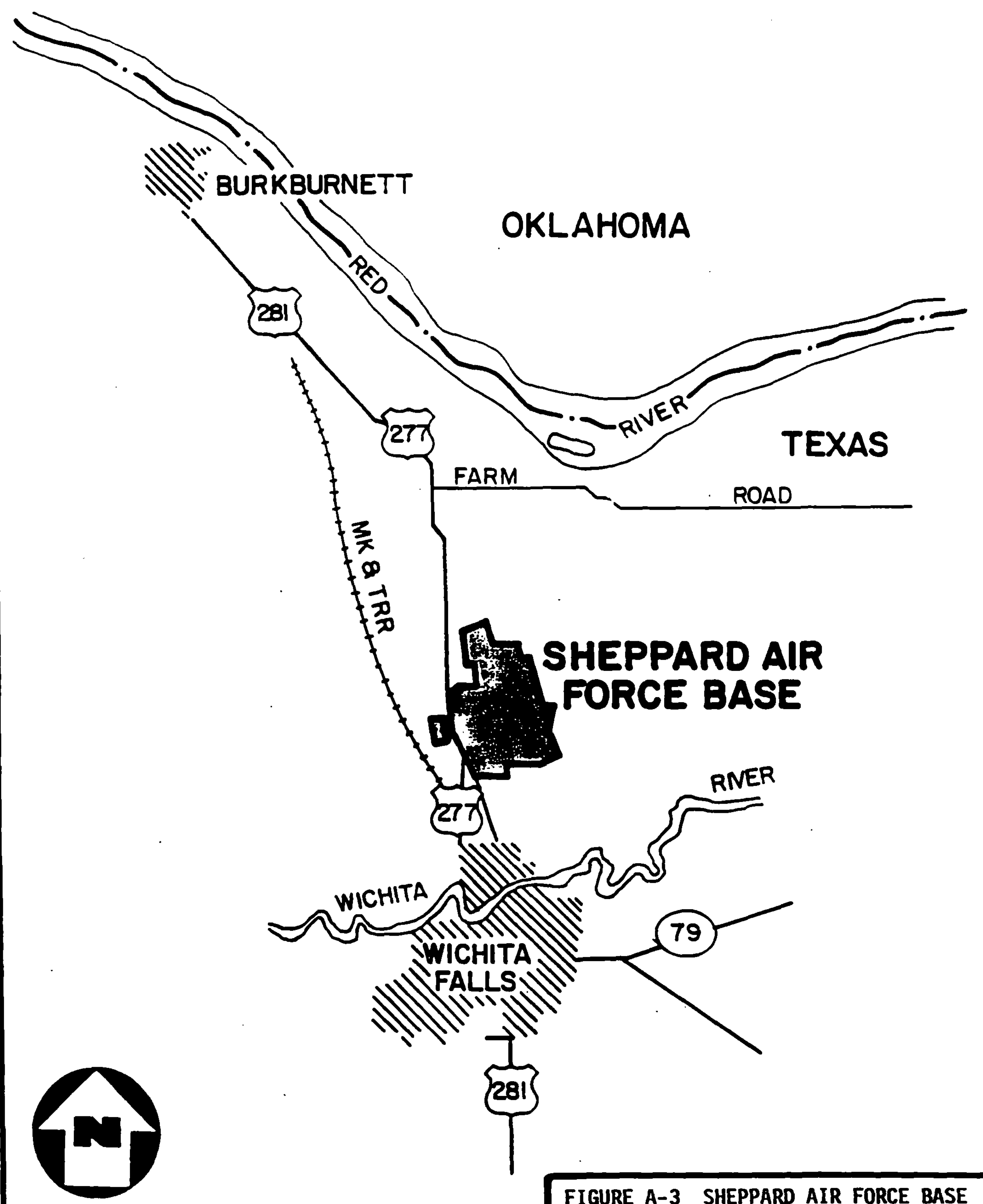
REGIONAL LOCATION MAP

NOT TO SCALE

FIGURE A-2 SHEPPARD AIR FORCE BASE
REGIONAL LOCATION MAP

SOURCE: PHASE I - RECORDS SEARCH
FEBRUARY, 1984

NUS CORPORATION



SHEPPARD AIR FORCE BASE
AREA LOCATION MAP
1" = 3 MILES

FIGURE A-3 SHEPPARD AIR FORCE BASE AREA LOCATION MAP
SOURCE: PHASE I - RECORDS SEARCH FEBRUARY, 1984

NUS CORPORATION

The Waste Pits were subject to a Phase II - Confirmation/Quantification Study. In this study, no ground water was encountered in the clayey soils, however; oil and grease contamination was found at depths up to 30 feet. A geophysical survey, conducted as a part of this study, failed to discern the boundaries of the original pits or any contaminant plume(s).

Landfill 1 (LF-1)

Landfill 1 was operated from 1941 until about 1957, when it was completely closed and graded for construction of the base golf course. Some portions of the landfill, namely those on the west side of the fill, were closed about 1952 and base housing was subsequently constructed on the area. Precise dimensions of the total area used as landfill are uncertain, but aerial photographs and interviews with base personnel indicate the approximate boundaries shown in Figure 4-2; placement of these boundaries gives a total landfill area of approximately 100 acres. The landfill was a trench-and-fill operation, with trenches about 14 feet deep running east-west. Burning of wastes at the site occurred regularly throughout its period of use. The wastes were primarily normal base refuse, but some additional materials were disposed of, including incinerator ash, sludge from the wastewater treatment plant drying beds, and some hardfill and construction rubble. Important considerations at Landfill 1 are the adjacent structures, which include the wastewater treatment plant, a small low-level radioactive waste disposal well, an early fire protection training area, and an ordnance building. The wastewater treatment facility and radioactive waste well are in the area north of the landfill site; the other structures were removed for golf course construction. Most waste combustible liquids were used in fire protection training. Hence, it is assumed that little or no waste fuel and oil were deposited in this landfill.

Landfill 2 (LF-2)

Landfill 2 is a rectangular-shaped area approximately 7 acres in size (see Figure 4-3). It is located south of the present municipal airport complex and was operated for about 3 years during the early 1960s. Landfill operations entailed trench-and-fill procedures; trenches ran east-west and were approximately 10 to 14 feet deep. As far as can be determined, only normal base refuse was disposed of in Landfill 2. Burning of the refuse was performed during the period of use. At the present time, the landfill area is covered with natural local vegetation. The site formerly occupied by the trenches contains a growth of mesquite trees, which is noticeably more dense than that of the surrounding area.

Landfill 3 (LF-3)

Landfill 3, comprising about 60 acres at the northwest corner of the base, was operated from about 1957 until 1972. The landfill area is located east of State Highway 240 and in an area bounded approximately by Missile Road, the Motor Pool area, the Munitions Storage area, and the City of Wichita Falls treatment facility property (see Figure 4-4). Low-Level Radioactive Waste Disposal Area 2 (LLRW-2) is located near the center of LF-3. Part of LF-3 is presently used as a grenade launcher and small arms range. The material disposed of in this landfill was primarily normal base refuse and some waste treatment sludge; the operation was performed as trench-and-fill, with east-west trenches approximately 14 feet deep. Burning of the refuse occurred until 1968, after which no further burning was performed. Landfill 3 was first opened near Missile Road. It was progressively opened north to northeast, so that by the early 1970s, the area of use was west of the Munitions Storage Area. From about 1965 to 1970, trenches at the north area of the landfill, near Munitions Storage, received waste oils and refuse. Volume estimates ranged from one 55-gallon drum of waste oil per week to one 55-gallon drum per day.

A subsurface investigation was conducted at LF-3, in conjunction with the Phase II report. The soil at the site consisted primarily of clayey silts and ground water was encountered at two locations near the unnamed creek. Some contamination was detected in the ground-water samples. The report concluded that off-base migration of contaminants could not be discounted.

Fire Protection Training Area 1 (FPTA-1)

Site FPTA-1, located adjacent to the Landfill 1 (see Figure 4-5), was used as a fire protection training area from 1941 until 1957. The site consisted of a depressed burning area and three old aircraft. A drum storage area north of and adjacent to the site was used to store between 100 and 200 55-gallon drums of contaminated oils, fuels, and waste solvents from aircraft maintenance and industrial shop activities. The frequency and duration of burns during the 1940s is unknown.

During the 1950s, the drums were transported by flat-bed truck from the drum storage area to the fire protection training site; the drums were drained and, then, burns occurred. During the 1950s, four or five burns occurred each weekend day. Each burn constituted about 400 to 500 gallons of material. As far as can be determined, no drainage collection system was operational at this site.

Visual examination of the area presently reveals no remaining signs that the site was once a fire protection training area. The site is filled in and is a part of the base golf course. Due to the nature and duration of the activity at this site and the relatively shallow depth to ground water, a potential for contaminant migration exists.

A subsurface investigation was conducted at FPTA-1, in conjunction with the Phase II investigation. The confirmation study concluded that contamination is present on the site in the shallow ground water. A contaminant plume was identified by an EM survey. The report stated that the potential exists for on base and off base contamination.

<u>Fire Protection Training Area 2 (FPTA-2)</u>

Site FPTA-2, located north of the municipal airport terminal and Taxiway C (see Figure 4-6), was used as a small-scale fire protection training area from about 1968 until 1976. Typical usage consisted of one burn of contaminated oil, fuels, and solvents every 3 to 6 months. Portions of an oil-water separator, connected to a storm drain, exist at the site.

The surface soils in this area have been disturbed for construction of runways. Adjacent soils are composed of silty loam, with relatively low permeabilities. Ground water may occur at less than 10 feet below ground. A nearby test boring for Runway 33L encountered clay from 0 to 13 feet deep, with two minor lenses of coarse sand and gravel less than 6 inches thick at 7- and 11-foot depths.

<u>Fire Protection Training Area 3 (FPTA-3)</u>

Site FPTA-3, located adjacent to the northern corner of the old municipal runway (presently Bridwell Road), was activated in 1957, when FPTA-1 was closed for construction of the golf course. This site is in use at the present time. The site consists of a storage area containing three 2,000-gallon elevated tanks, a concrete block building, a mock-up of a T-38 used for fire training, a C-130A aircraft for rescue training, and a waste drainage and collection system (see Figure 4-7). The drainage and collection system, installed in 1982, consists of drainage collection and piping leading to an oil-water separator, and a water storage pond. The unburned fuel, which drains into the oil-water separator, is pumped to the storage tanks for reuse. The water phase flows to the pond, from which it discharges to the sanitary sewer. Present burn frequency is approximately quarterly and approximately 300 gallons of fuel is consumed per burn. Prior to 1982, no waste collection and separation system was in operation at this site.

Natural soils in the area of FPTA-3 are composed of silty loam with relatively low permeabilities. Ground water may occur at less than 10 feet below ground. A nearby test boring at Building 2013 encountered clay from 0 to 15 feet below ground.

Visual examination of the area indicated surficial contamination and a fuel odor. Due to the duration and frequency of operations, as well as the lack of a waste oil reclamation facility until recently, a potential for contaminant migration exists at the site.

FPTA-3 was subject to a subsurface investigation as part of the Phase II investigation. This study identified contaminated sandy and clayey soils beneath the site. In addition, ground-water contamination was substantiated at the site by laboratory analyses.

<u>Industrial Waste Pit (WP-2)</u>

An earthen industrial waste pit, just north of the wastewater treatment facility, was used during the 1950s as a storage pond for waste oils and fuels from the old engine test cells (see Figure 4-8). An industrial waste line ran south from the test cells to the pit. The oils in the pit were burned on at least one or two occasions during the 1950s. The pit is no longer used for industrial waste storage. It is presently used as an overflow basin for the effluents from the oil-water separator.

Pesticide Spray Area (PSA)

Pesticide applications have been performed by the Entomology Shop, Golf Course Maintenance, and Roads and Grounds. In 1979, the responsibility for herbicide application around the base areas other than the golf course was delegated to the Entomology Shop. The Entomology Shop has always been located in Building 4493, adjacent to the waste treatment plant (see Figure 4-9). This building has been used for both storing and mixing the chemicals. Rinse water generated from cleaning the application equipment and empty containers has been dispensed over a gravel lot adjacent to the building. Rinsed containers have been crushed and disposed of with general refuse.

Low-Level Radioactive Waste Disposal Site (LLRW-1)

The disposal well adjacent to the wastewater treatment plant is concrete-lined, about 6 inches in diameter and 14 feet deep, and is surrounded by a locked, fenced area (see Figure 4-9). The well was reportedly installed in the early 1950s for the disposal of X-ray waste from the Sheppard AFB hospital. It is alleged that, on one occasion during the mid- to late-1950s, the well was used to dispose of a quantity of material. However, the volume, identity, and source of material are unknown. No written base records are available to indicate whether the site has been used.

Low-Level Radioactive Waste Disposal Site in Landfill 3 (LLRW-2)

The radioactive waste burial vault in Landfill 3 is in a marked area approximately 100 feet square (see Figure 4-4). It is alleged that the site was activated and marked in the late 1950s or early 1960s and that a radioactive tool or wrench used in munitions maintenance may have been deposited in the vault on one occasion. No written base records are available to indicate whether the site has been used.

A.3.0 SCOPE OF ACTIVITIES

The scope of NUS' activities varies from site to site on the installation. The activities at the 11 sites include: mobilization/demobilization, geophysics, soil borings and concurrent soil sampling, monitoring well installation, well surveying, groundwater sampling, surface and near-surface soil sampling, sediment sampling, surface water sampling, and equipment/personnel decontamination.

A breakdown regarding the specific scope of work for each site can be found in Section 4.0 of this Work Plan. In addition, general site-specific activities are included in Table A-1.

A.4.0 HAZARD EVALUATION

This hazard evaluation assesses the health and safety concerns involved with the anticipated site tasks, based on available site-specific information. As additional information becomes available, these potential risks may or may not be altered. If alterations are necessary, the HASP will be modified to address any such changes. The hazards involved with this project will vary with the site and tasks to be performed. The greatest concern for health and safety involves worker contact with potentially contaminated waste during subsurface activities and sampling operations. However, after reviewing past contaminant concentration data, some of which can be found in Table A-2, it is believed that levels will be below the Occupational Safety and Health Administration's (OSHA's) Permissible Exposure Limits (PELs), and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs).

Notwithstanding, personnel still must monitor all work locations. Any readings above background shall call for Level B protection, unless background levels are again achieved or the substance is identified and determined to be nonhazardous. The reasoning behind this requirement can be found in Section A.8.0. The following is a breakdown of the various tasks to be performed at Sheppard AFB and an evaluation of the hazards which pertain to each.

MOBILIZATION/DEMOBILIZATION

Very small possibility of contacting waste. If readings on monitoring instruments do exceed background, however, personnel shall retreat from the area until levels subside. Level D protection will be used for this task. See Personal Protective Equipment, Section A.7.0.

TABLE A-1

PPE AND MONITORING INSTRUMENTS
SHEPPARD AFB

Activity	PPE	Monitoring Instruments
1. Mobilization (all sites)	Steel toe/shank workshoes or boots, standard field clothes (long sleeved shirt and long pants). Boot covers	General air quality scan with HNU and OVA
2. Geophysics	Steel toe/shank workshoes or boots, standard field clothes, boot covers, surgeon's inner gloves, outer work gloves, eye protection (safety glasses with side shields or monogoggles). Hard hat (if overhead hazard exists).	General air quality scan with HNU
3. Soil boring (with concurrent soil sampling) and monitoring well installation.	Steel toe/shank workshoes or boots, standard field clothes. Hard hats, eye protection, boot covers, Tyvek coveralls, surgeon's inner gloves, nitrile outer gloves, tape up joints. Use Tyvek PE or PVC when drilling through known waste areas; (i.e., FPTA or if sludge-like conditions exist). Regular Tyvek shall be used for perimeter drilling. If dusty conditions exist, control dust or use full-face air-purifying respiratory protection with GMCH cartridges. A decision as to the use of splash shields will be made in the field by the project or alternate HSO. If sludge or greaselike conditions are noted at the FPTAs or Waste Pit Area, Viton gloves will substitute for nitrile to provide optimum protection against JP-4 and Transformer Oil.	HNU and LEL/0_2 meter. Periodic use of OVA to detect possible presence of contamination that the HNU may not detect.
4. Well Surveying	Boot covers, surgeon's inner gloves, outer work gloves if wells are capped, and standard field clothes. Boot covers, surgeon's inner gloves, nitrile outer gloves if wells are open. (Level D w/o respiratory protection)	HNU LEL/0_2 meter if wells are open Periodic OVA screening for purposes similar to 3.
5. Ground-water sampling at all sites where wells are installed.	Eye protection, boot covers, standard field clothes, Tyvek coveralls, surgeon's inner gloves, nitrile outer gloves, tape up joints. Tyvek PE or PVC when sampling in FPTAs or Waste Pit Area, or if well-head responses are noted on the HNU or OVA. Glove modification/respiratory protection - same as 3. Field decision for any modification of protective equipment will be made by project or alternate HSO.	HNU, LEL/02 meter. Periodic OVA screening for purposes similar to 3.

TABLE A-1
PPE AND MONITORING INSTRUMENTS
SHEPPARD AFB
PAGE TWO

Activity	PPE	Monitoring Instruments
6. Surface and near-surface soil sampling to take place at all sites.	Standard field clothes, eye protection, boot covers, Tyvek coveralls, surgeon's inner gloves, nitrile outer gloves, tape up joints. If dusty conditions exist, control dust, or use full-face air-purifying respiratory protection with GMCH cartridges.	HNU - periodic OVA screening for purposes similar to 3.
7. Surface-water and sediment sampling to take place at the following sites: WP-1 LF-1 LF-3 FPTA-3 WP-2	Eye protection, boot covers, standard field clothes, Tyvek PE or PVC in all areas due to wetness factor and location of most samples. Surgeon's inner gloves, nitrile outer gloves, tape up joints. Field decision regarding use of splash shields. Hip waders will be used if walking through water.	HNU - Periodic use of OVA for purposes similar to 3.
8. Decontamination of equipment	Same PPE that was used for task in question.	If no monitoring instrument action levels were obtained while performing the task in question, monitoring instruments not necessary.
9. Demobilization (all sites; varies with the activity being demobilized)	Same PPE that was used during the task of mobilization.	General air quality scan with HNU and OVA only if monitoring instrument action levels were obtained while performing the task being demobilized.

TABLE A-2

SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Transformer Oil (possible PCBs) (Example - Aroclor 1254)	Varies with specific compound: Aroclor 1254 = 11097-69-1	Aroclor 1254 = 0.5 mg/m^3	Aroclor 1254 = 0.5 mg/m^3	Inhalation, absorption, ingestion, contact-irritating to eyes, skin, acne-forming dermatitis, dark urine. Suspected carcinogen, embryotoxic. Target organs: skin, eyes, liver.	Aroclor 1254: VP = 0.00006 mm MP = 50°F
JP-4	N.A.	N.A.	N.A.	Undergoing carcinogenic tests. Skin irritant, combustible liquid.	65% gasoline, 35% light petroleum distillate LEL = 1.3%
Cadmium (Solution) (Dust)	7440-43-9	0.2 mg/m^3 (dust) 0.1 mg/m^3 (fume)	0.05 mg/m^3	Inhalation, ingestion - Pulmonary irritation, dermatitis or allergic sensitization. Overexposure symptoms: dry burning throat, headaches, muscle aches, chest tightness and pain, nausea, chills and fever, diarrhea, insomnia, emphysema, proteinuria, anemia. Suspected carcinogen. Target organs: respiratory system, kidneys, prostate, blood.	

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE TWO

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
General: Metals Not all inclusive - only generalities can be listed.	Varies with specific compound	Varies with specific compound	Varies with specific compound	Varies from compound to compound - Exposure to specific metals can perpetrate the following: CNS and GI disorders, skin sensitization, hemalysis, metal fume fever, Burton line, teratogenic effects, mental effects, eye, skin, respiratory irritation. Confirmed carcinogen - arsenic, nickel, chromium (hexavalent), suspected carcinogen - beryllium, lead, and cadmium.	This general section is included, since metals are a sampling parameter. Note that other sections of this table contain specifics of metals that may be predominant on the various sites. It is expected that, at this point, metal contamination will adhere to dust particles and proper PPE should afford protection.
Organic Solvents- Not all inclusive; only generalities can be listed.	Varies with specific compound	Varies with specific compound	Varies with specific compound	Aliphatic and alicyclic - narcosis (principle hazard-fire/explosion) Aromatic hydrocarbons - benzene is a carcinogen, others are toxic but less than benzene; pleasant odors at low concentrations, narcotic, irritating. Halogenated aliphatic and aromatic - narcosis, some are carcinogenic (i.e., vinyl chloride).	Fire and explosion potential due to chemical properties of certain solvents.

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE THREE

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Organic Solvents-(continued)				Aliphated alcohols - narcosis Cyclic and aromatic alcohols - phenol acts on the CNS and an overexposure by any route leads to rapid collapse and death, probably by respiratory paralysis. Ketones - narcotic irritant and the irritation of eyes and nose usually suffice to limit exposure. Carbon tetrachloride - liver and kidney damage.	
Sulfuric Acid (clear colorless, hygroscopic oily liquid, no color)	7664-93-9	1 mg/m3	1 mg/m3	Inhalation, ingestion, contact - eye, nose and throat, irritating pulmonary edema, bronchial emphysema, conjunctivitis, stomatis, dental erosion, skin, eye, burns, dermatitis. Target areas - respiratory system, eyes, skin, teeth.	V.P. <001 mm MP 37°F Not combustible, but highly reactive.

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE FOUR

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Ethylene Glycol (colorless, sweet tasting; poisonous; hygroscopic liquid; practically odorless)	107-21-1	125 mg/m^3 (ceiling vapor) 10 mg/m^3 (particulate)	50 ppm (vapor, mist)	Moderate irritant via skin, eyes, and mucous membrane via oral, intravenous, and intraperitoneal routes. If ingested, causes initial central nervous system stimulation followed by depression. Very toxic in particulate form causes kidney damage. Respiratory arrest or cardiovascular collapse, acute renal failure with uremia. Skin absorption may also contribute to intoxication.	BP 387°F VP 0.06 MW 62.08 F.P. - 12.7°C Sp Gr 1.12
Gasoline	8006-61-1	900 mg/m^3 300 ppm	900 mg/m^3 300 ppm	Dermal exposure can cause dermatitis, skin blistering. Inhalation and oral routes, CNS depressions. At high concentration, pulmonary edema. Excessive vapors can cause inebriation (ingestion). Drowsiness, blurred vision, vertigo, confusion, vomiting, and cyanosis.	F.P. 50°F LEL 1.3% UEL 6.0

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE FIVE

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Pesticides (examples) Insecticides:				[A] Organophosphates [B] Carbamates Exposure through ingestion, skin, eyes, and inhalation. Intermediate symptoms are headache, fatigue, dizziness, blurred vision, excessive sweating, stomach cramps, diarrhea, salivation. Severe exposure: unable to walk, chest pains, meiosis, muscle twitching, unconsciousness, generalized seizures, cholingeric crisis. [C] Chlorinated Hydrocarbons Inhalation, absorption, ingestion skin/eye contact. Dizziness, nausea, abdominal pain, vomiting, severe irritability, convulsive seizures, coma, elevated body temperature, unconsciousness, labored breathing with vigorous, rapid pulse.	This is a general section listing some examples of the various chemicals used throughout the Base. It is expected that contamination may be present on dust particles or in empty containers in the landfills.
Abate[A]	3383-96-8	--	10 mg/m3		
Baygon[B]	114-26-1	--	0.5 mg/m3		
Carbamate[B]	14484-64-1	--	10 mg/m3		
Chlordane[C]	57-74-9	15 mg/m3	0.5 mg/3		
Diazinon[A]	331-41-5	--	0.1 mg/m3		
Lindane[C]	58-89-9	--	0.5 mg/m3		
Malathion[A]	121-75-5	15 mg/m3	10 mg/m3		

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE SIX

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Pesticides (examples) - (continued) Herbicide: Ammonium Hydroxide Diquat	 1336-21-6 85-00-7	 -- --	 -- 0.5 mg/m^3	General effects: Inhalation, absorption, ingestion - skin/eye contact - paresthesia of tongue, lips, face; tremors; apprehension, dizziness, confusion, malaise; headache; convulsions; incomplete loss of muscle power; weakness of a limb; vomiting, skin and eye irritant. Target organs: central nervous system, kidneys, liver, skin, peripheral nervous system.	
Methyl ethyl ketone (MEK)	78-93-3	200 ppm - TWA	200 ppm - TWA 300 ppm - STEL	Inhalation - eyes, nose, and throat irritant. May cause narcosis	F.P. - 21°F LEL - 1.8% B.P. - 175°F V.P. - 70 mm Hg
Methanol	67-56-1	200 ppm TWA	200 ppm - TWA 250 ppm - STEL	Inhalation, ingestion, skin irritant. Affinity for optic nerve, so may cause blindness.	F.P. - 52°F LEL - 7.3% B.P. - 147°F V.P. - 95 mm Hg
1,2-Dichloro-benzene	95-50-1	50 ppm - C	50 ppm - C	Inhalation, ingestion, and absorption. May cause eye and nose irritation, liver or kidney damage, and possible skin blistering.	F.P. - 151°F LEL - 2.2% B.P. - 356°F V.P. - 1.2 mm Hg

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE SEVEN

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
1,4-Dichloro-benzene	106-46-7	75 ppm - TWA 110 ppm - STEL	75 ppm - TWA 110 ppm - TWA	Inhalation, ingestion. May cause nausea, vomiting, eye irritation,and rhinitis.	F.P. - 150°F LEL - 2.5% B.P. - 345°F V.P. - 0.4 mm Hg
Trichloroethane	71-55-6	350 ppm - TWA	350 ppm - TWA 450 ppm - STEL	Inhalation. Irritates eye, nose, and throat. Also causes CNS depression, liver, and kidney damage.	F.P. - None LEL - 6% B.P. - 236°F V.P. - 19 mm Hg
Trichloro-ethylene	79-01-6	100 ppm - TWA 200 ppm - C	50 ppm - TWA 200 ppm - STEL	Inhalation causes vertigo; tremors, somnolence, nausea, vomiting, dermatitis, and possibly cancer.	F.P. - None LEL - 11% B.P. - 188°F V.P. - 58 mm Hg
Toluene	108-88-3	200 ppm - TWA 300 ppm - C	100 ppm - TWA 150 ppm - STEL	Inhalation and skin irritant, moderate eye, nose, and throat irritant. Will cause narcosis.	F.P. - 40°F LEL - 1.2% B.P. - 231°F V.P. - 30 mm Hg
Bromoform	75-25-2	0.5 ppm	0.5 ppm	Inhalation or ingestion. May cause eye and respiratory system irritation, central nervous system depression, and liver damage.	F.P. - Noncombustible LEL - None B.P. - 298°F V.P. - 5 mm Hg
Naphtha	91-20-3	100 ppm - TWA	100 ppm - TWA 150 ppm - STEL	Routes of entrance into the body include inhalation and ingestion. This may cause lightheadedness, drowsiness, dermatitis, and/or eye, nose, and throat irritation.	F.P. - 100°F LEL - Unknown B.P. - 230°F V.P. 5 mm Hg

TABLE A-2
SUSPECTED/KNOWN SUBSTANCES ON SITE
SHEPPARD AFB
PAGE EIGHT

Substance	CAS No.	Current OSHA Environmental Exposure Limit	ACGIH Recommendation for Environmental Exposure Limit	Health Effects Considered (some symptoms and target organs)	Comments/Physical Properties
Ethyl benzene	100-41-4	100 ppm - TWA	100 pm - TWA 125 ppm - STEL	Inhalation or ingestion. May cause irritation of the eyes or mucous membrane, dermatitis, narcosis, and upon extreme exposure, coma.	F.P. - 59°F LEL - 1.0% B.P. - 211°F V.P. - 7.1 mm Hg

Note: Acronyms are as follows:

CAS No. = Chemical Abstracts Service Identification Number
OSHA = Occupational Safety and Health Administration
ACGIH = American Conference of Governmental Industrial Hygienists
STEL = Short-Term Exposure Limit
C = Ceiling Limit
BP = Boiling Point
MP = Melting Point
NA = Not Applicable
VP = Vapor Pressure
mmHg = Millimeters of mercury

LEL = Lower Explosive Limit
UEL = Upper Explosive Limit
GI = Gastro-Intestinal
CNS = Central Nervous System
PPE = Personal Protective Equipment
MW = Molecular Weight
F.P. = Flash Point
Sp. Gr. = Specific Gravity
mg/m^3 = Milligrams of substance per cubic meter of air
ppm = Volumes of substance per million volumes of air
TWA = Time-weighted average

GEOPHYSICS

Similar hazards as those found in the mobilization/demobilization section, but surgeon's inner gloves and outer work gloves will be worn due to the potential for contacting waste while on site.

SOIL BORING

This task represents the most serious hazards involved with the project. Because of the presence of both inorganic and organic materials at the boring locations, personnel will have to be protected from both organic vapors and inorganic particulates. If conditions become dusty, a particulate filter with an air-purifying respirator will need to be used. Workers shall try to minimize dust by watering down the area. If readings on the organic vapor monitoring instruments exceed background levels in the breathing zone, Level B protection will be used. See PPE in Section A.7.0.

WELL SURVEYING

Similar hazards as those found in the geophysics section.

GROUND-WATER SAMPLING

This task represents a hazard to workers from being exposed to contaminated ground water. Personnel will be vulnerable to the vapors of material released from the ground water and also to chemicals being absorbed through the epidermis, if the water comes into contact with exposed skin. The specified clothing and monitoring required during this task is described as part of personal protective equipment (PPE) in Section A.7.0.

SOIL SAMPLING

This task is similar to the ground-water task mentioned above; however, the exposure to vapors will be less than that of ground water, because most chemical molecules will attach themselves to soil particles. Dusty conditions must be controlled with the use of water or some other method. See PPE in Section A.7.0.

SURFACE-WATER SAMPLING

This task involves a lesser potential for contact of contamination than the ground-water task. This situation is due to evidence that concentrations in surface water are lower than those found in ground water. Personnel shall follow all the PPE requirements found in Section A.7.0 of this HASP, including the water-safety requirements.

DECONTAMINATION OF EQUIPMENT

These tasks involve a slightly lesser hazard potential than the particular task for which they are being performed. Therefore, decontamination personnel will adhere to the same level of protection as that being donned for the task in question.

PHYSICAL HAZARDS

Aside from hazards presented by chemical substances, physical hazards must also be addressed. Physical hazards could involve such items as

- Contact with energized sources.
- Exposure to moving machinery, particularly during drilling activities.
- Uneven or unstable terrain (e.g., slip, trip hazards).
- Manual lifting techniques.

Subcontractor personnel utilizing items of machinery on site (i.e., drill rigs) shall ensure that the items are properly guarded, maintained, and operated. No masts or any other projecting equipment shall be permitted within a 20-foot radius of energized sources. Also, any areas targeted for subsurface investigation shall first be investigated to determine the presence of underground utilities.

Personnel are to be advised regarding hand/clothing contact with moving machinery pinch points. Protective gear must fit properly and be taped, not only to control chemical exposure but also to avoid becoming caught in moving machinery. Additionally, equipment shall be shut down and locked out before maintenance functions are performed.

During any manual material handling tasks, personnel are to lift the load with their legs and not with their backs. Also, the correct number of personnel must be used to lift or handle heavy/bulky equipment. These procedures are to be employed to avoid back strain.

A.5.0 MEDICAL SURVEILLANCE

All personnel performing activities at Sheppard Air Force Base must first obtain a current medical certificate. NUS employees meet this stipulation, since they are required to participate in the company Medical Monitoring Program in order to participate in hazardous waste field activities. NUS subcontractors are required to obtain a certificate from a physician stating that they may perform their assigned tasks, including the use of respiratory protection equipment. An example of this certificate is included as Attachment A-1. The parameters of the medical examinations and any need for additional testing of personnel will be at the discretion of the examining physician(s).

A.6.0 TRAINING

Prior to performing any field duties at Sheppard Air Force Base, all site personnel must meet health and safety training requirements in accordance with OSHA Standard 29 CFR 1910.120 Paragraph (e). These requirements include 40 hours of introductory training for personnel and an additional 8 hours of training for site supervisors. In addition, 8 hours of refresher training are required annually for all applicable personnel. NUS employees must meet these requirements in accordance with NUS' Standard Operating Procedures (SOPs). NUS subcontractors must present documentation that confirms to the attainment of these OSHA training requirements to the Project HSO, prior to work initiation.

In addition to the aforementioned training, all personnel must attend a project-specific training session, which will be conducted immediately preceding field activities. This training will consist of the following:

- Names of personnel and their alternates who are responsible for health and safety.

- Safety, health, and other hazards present on the sites.

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SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of ____
Company Name

Participant Name: ______________________ Date of Exam: ______________________

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -

   ( ) qualified to perform work at the ____________________ work site
   ( ) not qualified to perform work at the ____________________ work site
   and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134 (b)(10) and found to be medically -

   ( ) qualified to work in respiratory protection
   ( ) not qualified to work in respiratory protection

My evaluation has been based on the following information, as provided to be by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee which is not readily available to the examining physician.

Part B

I, ______________________, have examined ______________________________
Physician's Name (print) Participant's Name (print)
and have determined the following information:

1. Results of the medical examination and tests (excluding findings or diagnoses unrelated to occupational exposure):

____

____

____

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2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

____

____

____

3. Recommended limitations upon the employee's assigned work:

____

____

____

____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination or treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the ______________________________ work site, this participant

( ) may
( ) may not

perform his/her assignment task.

Physician's Signature ____________________

Address ____________________

Phone Number ____________________

NOTE: Copies of test results are maintained and available at:

____
Address

Attachment A - Subcontractor Medical Approval Form

- Proper use of personal protective equipment (see Section A.7.0).

- Work practices and restrictions to minimize hazard potentials on the sites.

- Safe use of any implemented engineering controls and equipment on the sites.

- Medical surveillance requirements, including the recognition of symptoms for overexposure to substances known or suspected to be on the sites (as presented in Section A.4.0 and Table A-2 of this HASP).

- Monitoring instrumentation to be used on the sites.

- The contents of this HASP.

- Handling procedures for drums and other containers.

- Decontamination procedures.

- Emergency procedures.

- Field communications.

A.7.0 PERSONAL PROTECTIVE EQUIPMENT

In view of the known/suspected substances on the sites and the planned field activities involved in this project, personal protective equipment (PPE) will be used to minimize the potential for onsite personnel exposures. The protection provided by the PPE will be augmented by the use of monitoring instrumentation (see Section A.8.0). PPE requirements may need to be modified (upgraded or downgraded) throughout the course of activities on the installation due to environmental concerns (i.e., dusty conditions, reaching and exceeding monitoring instrument action levels) and/or if additional data becomes available. No alterations shall be permitted without the prior, written approval of the HSO. Any significant modifications shall be communicated to Energy Systems and the USAF via the NUS project manager. PPE and monitoring instrument usage are described in

Table A-1. In addition to this information, it must be noted that NUS personnel are also required to wear TLD (thermoluminescence dosimetry) badges during all field activities, even when radiation exposure is not anticipated. This requirement is in accordance with NUS Health and Safety Standard Operating Procedures (SOPs).

It is anticipated that most field activities can be conducted in Level D protection. However, if the HSO determines that either Level C or Level B protection is required (due to monitoring instrument action levels or site observations), NUS SOPs will be instituted. A copy of the SOPs will be kept on site.

The following provides general descriptions of Levels B, C, and D protection.

Level B personal protective equipment includes

- Positive pressure-demand, SCBA (MSHA/NIOSH approved).
- Chemical-resistant clothing.
- Gloves (outer), chemical-resistant.
- Gloves (inner), chemical-resistant.
- Boots (inner), chemical-resistant, steel toe.
- Boots (outer), chemical-resistant (disposable).*
- Hard hat (face shield*).
- Two-way radio communications (intrinsically safe).
- Personal radiation detector.

Level C personal protective equipment includes:

- Full-face, air-purifying, canister-equipped respirator (MSHA/NIOSH approved) with appropriate canister.

- Chemical-resistant clothing.

- Gloves (inner), chemical-resistant.*

- Gloves (outer), chemical-resistant.

---

* Optional - used only if designated by Project HSO.

- Boots (inner), chemical-resistant, steel toe.

- Boots (outer), chemical-resistant (disposable).*

- Hard hat (face shield).*

- Escape mask.*

- Two-way radio communications (intrinsically safe).

- Personal radiation detector.

Level D personal protective equipment includes

- Coveralls.
- Gloves.*
- Boots (inner), chemical-resistant, steel toe.
- Boots (outer), chemical-resistant (disposable).*
- Safety glasses.
- Hard hat.
- Escape mask.*

A.8.0 MONITORING INSTRUMENTS

To monitor the health and safety of NUS employees and subcontractors, real-time monitoring instruments will be used at Sheppard AFB to detect airborne chemical hazards. Real-time monitoring instruments provide information on the quality of air in the work zone. These instruments include a lower explosive limit indicator, an oxygen detector, a photoionization detector, a flame ionization detector, and colorimetric tubes. These instruments will be used during activities, such as drilling and sampling operations to detect the presence of hazardous substances in air. As noted previously, Table A-1 details monitoring instrument usage relative to the specific site and task in question.

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* Optional - used only if designated by Project HSO.

A.8.1 LOWER EXPLOSIVE LIMIT AND OXYGEN INDICATOR(LEL/O_2 METER)

The instrument to be used is capable of detecting both the percent of the lower explosive limit (LEL) and the percent of oxygen (O_2) in the air; thus, the instrument is commonly referred to as an LEL/O_2 meter. The MSA models 260 or 241 LEL/O_2 meters will be used at Sheppard AFB.

The LEL function of this instrument determines the level of organic gases and vapors present in the sampled air as a percentage of the lower explosive limit. The indicator measures from 0 percent to 100 percent of the LEL of the calibration gas, with 100 percent representing the lower explosive limit of organic gases and vapors relative to the calibration gas.

NIOSH criteria for action levels will be followed when interpreting LEL readings. These are as follows:

- $\geqq$ 10 percent LEL - Limit all activities in the area to non-spark generating activities. Wear non-spark producing gear and use non-spark tools and equipment.

- $\geqq$ 20 percent LEL - Cease all activities and evacuate to a safe atmosphere.

The O_2 function of this instrument measures oxygen concentration in the sampled air. Oxygen levels lower than 19.5 percent require the use of supplied air respiratory protection. Oxygen concentrations in excess of 25 percent constitute an oxygen-enriched atmosphere, which increases the potentials for fire and explosion. This level, or greater, requires that all site activities cease and personnel retreat to a safe atmosphere.

A.8.2 PHOTOIONIZATION DETECTOR

An HNU Model 101 Photoionization Detector (PID) will be used at Sheppard AFB. This instrument will be equipped with an 11.7 eV (electron volt) or a 10.2 eV probe in order to respond to known chemicals present, while providing a wide measurement range for organic (and some inorganic) gases and vapors in the air.

PIDs can monitor only certain vapors and gases. Nonvolatile liquids, toxic solids, particulates, and many other toxic gases and vapors cannot be detected; nor can the instrument identify unknown substances. The HNU provides real-time readouts of concentrations in units of parts per million (ppm). A reading of 10 ppm would indicate that some substance(s) in the sampled air are present at a concentration equivalent to 10 ppm of the calibration gas (benzene). As a result, any indicated readings on this instrument in the workers' breathing zone (above ambient background levels) will be a cause for personnel evacuation to a safe atmosphere. If readings do not subside, personnel should contact the NUS Health and Safety staff. Work can resume only when background levels are again achieved; supplied air respirator protection is donned; or the substance can be identified and determined to be nonhazardous.

A.8.3 FLAME IONIZATION DETECTOR (FID)

An Organic Vapor Analyzer (OVA) model 128 FID (manufactured by Foxboro) will be used as a second organic vapor detector. The OVA is similar to the PID, except that it uses the principle of flame ionization detection to ionize vapors/gases, as opposed to the photoionization lamp used in the PID.

The OVA is calibrated to methane; therefore all readings are in methane equivalents. As with the PID, the OVA cannot be used to identify specific unknown compounds (when in the survey mode). Also, it will not detect all chemical substances. The OVA will detect only combustible volatile organic substances; it will not detect inorganics. However, there are substances to which the OVA is sensitive that the HNU cannot detect and vice-versa. For these reasons and the fact that there are limited analytical data regarding installation contamination, principle monitoring activities include continuous use of the HNU with periodic OVA screening. This procedure will provide additional health and safety information to site personnel. In the event that two field activities occur concurrently and require HNU or OVA monitoring, the instruments will be periodically interchanged to provide optimum air quality information.

If OVA readings are sustained above background levels in the workers' breathing zone, personnel should evacuate to a safe atmosphere, following the same course of action as stated in Section A.8.2.

A.8.4 COLORIMETRIC TUBES

A Draeger bellows pump and tubes will be used to assist in identifying any organic and inorganic compounds detected in air. The pump is used to draw a known volume of air through a colorimetric tube. The colorimetric tube is packed with a substance that will change color (stain) if a certain substance (contaminant) is present in the sampled air. The determination of contaminant concentration is based on the length of the stain in the tube. The concentration is determined in parts per million (ppm) with an accuracy ranging between ±5 and ±40 percent, depending upon the contaminant being investigated and the tube being used.

Draeger tubes will be used in any attempts to identify compounds detected by either the PID or the OVA. They may also be used to assist in determining whether respiratory protection is needed.

Action level criteria in using Draeger tubes will be determined by comparing the sample results to the appropriate threshold limit values (TLVs), permissible exposure limits (PELS), or other relevant exposure limits.

As stated earlier, the real-time instrumentation will be used to aid in detecting the presence or absence of organic and inorganic vapors or gases during field activities. The Project (or Alternate) HSO will perform the monitoring of breathing zones, boreholes, and monitoring well heads.

A.8.5 MAINTENANCE AND CALIBRATION

Instrument maintenance and calibration is performed at the NUS Pittsburgh office.

The HNU photoionization detector (PID) is calibrated to benzene by the manufacturer once per year. This calibration is verified prior to instrument issuance by the NUS Equipment Manager. Field calibration is required by NUS Health and Safety SOPs at least once every 3 days on site (or after 24 hours of use). Field calibrations are performed using HNU manufacturer calibration span gas and adjusting, if necessary, the instrument span potentiometer control. This control is set at 9.8, when calibrated using a 10.2 eV probe. If the span potentiometer setting is less than 8.5, the instrument is returned for calibration. As with all NUS instruments, maintenance efforts are principally conducted at the NUS Pittsburgh office. When necessary, repairs are performed by the instrument manufacturer. Daily operational checks are typically performed through the use of a solvent-based magic marker, observing the instrument's needle deflection.

The Foxboro Organic Vapor Analyzer (OVA) flame ionization detector (FID) is calibrated to methane by the manufacturer. The instrument's operations and calibration are inspected at the NUS Pittsburgh office prior to being used on a field assignment. The OVA gas select knob is set at 300 when calibrated to methane. Daily operational checks are performed with a solvent-based magic marker (or some other flammable volatile organic), noting needle deflection.

The combustible gas indicator-oxygen indicator is also calibrated to methane or pentane gas and inspected prior to being issued on a job assignment. Daily operational checks with this instrument are typically performed using a butane cigarette lighter, checking instrument readouts and audible alarm functions. The audible alarm will sound when the combustible gas indicator exceeds 20 percent. The oxygen indicator will sound when the concentration of oxygen is below 19.5 percent. Maintenance and calibration procedures are in accordance with manufacturer's procedures. These are addressed in NUS' SOPs and will be kept onsite throughout the activities performed at Sheppard AFB.

A.9.0 SITE STANDARD OPERATING PROCEDURES

The following requirements apply to all field activities conducted at Sheppard AFB.

- Eating, drinking, chewing gum or tobacco, taking medication, smoking, or any other hand-to-mouth activities are prohibited in the exclusion or decontamination zones, where the possibility for the ingestion of contaminants exists.

- Personnel decontamination procedures (see Section A.10.0 of this HASP) must be followed.

- Contact with potentially contaminated substances, surfaces, and equipment must be avoided. Monitoring equipment must not be placed on potentially contaminated surfaces.

- No facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is allowed on personnel required to wear respiratory protective equipment.

- All NUS personnel must procure a copy of this HASP from the project HSO prior to commencing work on the installation. Additionally, a safety follow-up report must be filed with the Project HSO following completion of any task.

- All applicable personnel must satisfy medical surveillance requirements (see Section A.5.0 of this HASP).

- No flames or open fires will be permitted on the sites without the prior knowledge and approval of the Project HSO.

- No drilling or other such activities will be permitted within 20 feet in any direction of energized overhead power lines.

- No outdoor activities will be permitted during electrical storms or high winds.

- The monitoring instrument action levels presented in Section A.8.0 of this plan shall be observed.

- Monitoring of all drilling operations and ground-water sampling, as described in Section A.8.0 of this HASP, will occur.

- Monitoring equipment will be used on all well heads prior to and during sampling.

- Personnel must not lean directly over monitoring well heads. Also, personnel are to position themselves upwind of drilling operations.

- Subcontractor personnel will be responsible for employing safe operating procedures and complying with OSHA standards, while drilling and conducting other related field efforts.

- Prior to any intrusive activities (i.e., drilling) on site, the Base Fire Marshall shall be notified. Additionally, areas involved in such activities shall first be investigated to identify, locate, and avoid any subsurface utilities, containers, or other potential hazard sources.

- Emergency equipment, including portable fire extinguishers and first-aid kits, shall be maintained in the immediate vicinity of all work areas.

- All personnel must conduct their activities in a manner pursuant to the contents of this HASP and all of NUS' SOPs (dated August, 1987).

- Attachment A-2 (OSHA Poster) shall be posted at a conspicuous location on site so all personnel can see it. The posted document must be 8-1/2" x 14".

A.10.0 PERSONNEL DECONTAMINATION

Personnel decontamination is necessary to prevent the spread of contamination into unaffected areas and to minimize personnel exposure potentials. At Sheppard AFB, areas shall be designated as Contamination Reduction Zones (CRZs). These are the areas where decontamination efforts will take place. The CRZs will be designated by the Project HSO prior to the commencement or work. Separate areas for personnel and equipment decontamination will be designated. During the course of field activities, these locations may change, based on additional information and upon site observations. Personnel decontamination-generated wastes (i.e., spent wash/rinse fluids, disposable PPE) shall be collected, controlled, and disposed of in accordance with Section 3.9.5: Sampling Equipment Decontamination of this Work Plan.

Decontamination of personnel will consist of the following steps:

- Place all samples, sampling tools, and other carried items in the designated drop area.

- Wash coveralls, gloves, boot covers, respiratory protection equipment (if worn), and all other outer surfaces with a soap and water solution. This procedure is to be performed starting at the top of the body and continuing downward toward the feet.

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

William E. Brock, Secretary of Labor

U.S. Department of Labor
Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

- Rinse all washed outer surfaces with clean water.
- Remove and dispose of any tape.
- Remove and dispose of outer gloves.
- Remove coverall by rolling downward (dispose).
- Remove boot covers (dispose if grossly contaminated).
- Remove eye protection, if worn.
- Remove respiratory protection, if worn.
- Remove and dispose of inner gloves.
- Wash hands, arms, and face thoroughly in clean areas as soon as possible, as well as before eating or drinking.
- A total body wash should be performed as soon as possible after leaving the installation for the day.

A.11.0 EMERGENCY PROCEDURES

The following numbers can be used to obtain professional help:

Ambulance - 2333 (on base)
Police - 6302 (on base)
Fire Department - 117 (on base)
Base Safety - 4149 (on base)
Hospital - 2333 (on base); 911 (off base)
Poison Control - 2333 (on base); 911 (off base)
NUS Project Manager - Mr. Douglas W. Hodson (615) 483-9900
NUS Project HSO - Mr. Kevin A. Kenney (412) 788-1080 Ext. 464

If an injury or accidental exposure (inhalation, ingestion, or skin contact) to a hazardous waste occurs

- Remove the injured or exposed person(s) from immediate danger.

- Render any necessary first aid as per Attachment A-3 (a first-aid kit will be kept and maintained on site)

  - CPR/artificial respiration
  - Treatment for shock
  - Treatment for bleeding
  - Treatment for biological incidents (i.e., snake bites, etc.)

- Decontaminate affected personnel (if required)

- Call Sheppard AFB Safety Personnel

- Call ambulance for transport to the hospital. This procedure should be followed, even if there is no apparent serious injury.

- Evacuate other onsite personnel to a safe place until the Project Manager and the Project HSO report that it is safe for work to resume.

- Follow Emergency Physician Access Plan. (See Attachment A-4)

- Report the accident to the Project HSO immediately. The HSO shall communicate this information to all other applicable persons.

- File an incident report with the Program Manager of Health Sciences in Pittsburgh, Pennsylvania.

- The Project HSO is to develop safe operating procedures to reduce the possibility of recurrence.

American Red Cross

First Aid

EMERGENCY TELEPHONE NUMBERS
Police
Fire Department
Doctor
Ambulance
Hospital
Poison Control Center.

BITES Animal Bites - Thoroughly wash the wound with soap and water. Flush the area with running water and apply a sterile dressing. Immobilize affected part until the victim has been attended by a physician. See that the animal is kept alive and in quarantine. Obtain name and address of the owner of the animal.

Insect Bites - Remove "stinger" if present. Keep affected part down below the level of the heart. Apply ice bag. For minor bites and stings apply soothing lotions, such as calamine.

BURNS AND SCALDS Minor Burns - DO NOT APPLY VASELINE OR GREASE OF ANY KIND. Apply cold water applications until pain subsides. Cover with a dry, sterile gauze dressing. Do not break blisters or remove tissue. Seek medical attention.

Severe Burns - Do not remove adhered particles of clothing. Do not apply ice or immerse in cold water. Do not apply ointment, grease or vaseline. Cover burns with thick sterile dressings. Keep burned feet or legs elevated. Seek medical attention immediately.

Chemical Burns - Wash away the chemical soaked clothing with large amounts of water. Remove victim's chemical soaked clothing. If dry lime, brush away before flushing. Apply sterile dressing and seek medical attention.

CRAMPS Symptoms - Cramps in muscles of abdomen and extremities. Heat exhaustion may also be present.

Treatment - Same as for heat exhaustion.

CUTS Apply pressure with sterile gauze dressing, and elevate the area until bleeding stops. Apply a bandage and seek medical attention.

EYES Foreign Objects - Keep the victim from rubbing his his eye. Flush the eye with water. If flushing fails to remove the object, apply a dry, protective dressing and consult a physician.

Chemicals - Flood the eye thoroughly with water for 15 minutes. Cover the eye with a dry pad and seek medical attention.

FAINTING Keep the victim lying down. Loosen tight clothing. If victim vomits, roll him onto his side or turn his head to the side. If necessary wipe out his mouth. Maintain an open airway. Bathe his face gently with cool water. Unless recovery is prompt, seek medical attention.

FRACTURES Deformity of an injured part usually means a fracture. If fracture is suspected, splint the part, DO NOT ATTEMPT TO MOVE INJURED PERSON; seek medical attention immediately.

FROSTBITE Symptoms - Just before frostbite occurs skin may be flushed, then change to white or grayish-yellow. Pain may be felt early then subsides. Blisters may appear, affected part feels very cold and numb.

Treatment - Bring victim indoors, cover the frozen area, provide extra clothing and blankets. Rewarm frozen area quickly by immersion in warm water---NOT HOT WATER. DO NOT RUB THE PART. Seek medical attention immediately.

HEAT EXHAUSTION Caused by exposure to heat - either sun or indoors. Symptoms - Near normal body temperature. Skin is pale and clammy. Profuse sweating, tiredness, weakness, headache, perhaps cramps, nausea, dizziness, and possible fainting.

Treatment - Keep in lying position and raise victim's feet. Loosen clothing, apply cool wet cloths. If conscious, give sips of salt water (1 teaspoon of salt per glass) over a period of one hour If vomiting occurs, discontinue the salt water. Seek medical attention immediately.

SUNSTROKE Symptoms - Body temperature is high (106 degrees F or higher). Skin is hot, red, and dry. Pulse is rapid and strong. Victim may be unconscious.

Treatment - Keep victim in lying position with head elevated. Remove clothing and repeatedly sponge the bare skin with cool water or rubbing alcohol. Seek medical attention immediately.

POISONING Call the poison control center for instruction on immediate care. If victim becomes unconscious, keep the airway open. If breathing stops give artificial respiration, by mouth to mouth breathing. Call an emergency squad as soon as possible.

POISON IVY Remove contaminated clothing; wash all exposed areas thoroughly with soap and water followed by rubbing alcohol. If rash is mild, apply calamine or other soothing skin lotion. If a severe reaction occurs, seek medical attention.

PUNCTURE WOUNDS If puncture wound is deeper than skin surface, seek medical attention. Serious infection can arise unless proper treatment is received.

SPRAINS Elevate injured part and apply ice bag or cold packs. DO NOT SOAK IN HOT WATER. If pain and swelling persist, seek medical attention.

UNCONSCIOUSNESS Never attempt to give anything by mouth. Keep victim lying flat, maintain open airway. If victim is not breathing provide artificial respiration by mouth to mouth breathing and call an emergency squad as soon as possible.

ATTACHMENT A-4

EMERGENCY PHYSICIAN ACCESS PLAN
NUS CORPORATION

A. MONDAY THROUGH FRIDAY, 9:00 A.M. - 5:00 P.M.

Dial the (412) 648-3240 number. When answered state that:

(1) You are calling from NUS Corporation.
(2) This is an emergency call.

Program staff will be aware of how to contact the physician designated to provide emergency coverage on that day. Collect calls will be accepted.

B. EVENINGS, WEEK-ENDS, AND HOLIDAYS

Dial the (412) 648-3240 number. An operator from the answering service will answer the telephone. Do the following:

(1) Tell the operator that you are calling from NUS Corporation.

(2) Tell the operator that this is an emergency call.

(3) Give him/her your name.

(4) Give him/her the telephone number where the physician is to call. Be certain that he/she has written the correct number (area code and seven digits).

(5) If you do not receive a call back within 15 minutes, place a second call to (412) 648-3240.

Collect calls will be accepted.

C. SITUATIONS WHERE EMPLOYEE REQUIRES IMMEDIATE TRANSPORT TO A HOSPITAL

If the situation is life-threatening (i.e., cardiac arrest or person not breathing), call the emergency medical services system and transport the person to the nearest hospital with advanced life-support capabilities.

After obtaining assistance as stated above, call the (412) 648-3240 number and follow the procedures in A or B as appropriate.

Emergency Responsibilities

In the event that any work incidents occur during the course of site activities, the following personnel responsibilities shall be observed:

- All site personnel shall conduct their activities in accordance with the contents of this HASP.

- Incidents resulting in injuries requiring rescue operations shall be coordinated by the Project or Alternate HSO (whichever is present on site), who shall be assisted by either the Field Coordinator or the Sampling Team Leader and Sheppard AFB personnel.

- Communications with offsite response agencies (i.e., ambulance, fire department, etc.) shall be conducted by the Field Coordinator in coordination with the Project or Alternate HSO and Sheppard AFB personnel.

- In the event of an incident involving a release of contamination, fire, or other related occurrence, the Project or Alternate HSO shall be responsible for coordinating initial activities (i.e., site evacuation until appropriate Sheppard AFB emergency response personnel arrive). These efforts shall be assisted by the Field Coordinator.

- Upon site mobilization, the Project HSO shall establish emergency evacuation communication signals, evacuation routes, and personnel rendezvous locations. These shall be made known to all site personnel as part of the site-specific training session.

- The Project HSO is responsible for notifying Sheppard AFB and Energy Systems personnel of any site incidents that occur. This duty shall include a critique of response activities and corrective action efforts to minimize the possibility of recurrence.

Emergency Equipment

Emergency equipment to be used at the work locations shall consist of

- An industrial first-aid kit
- A portable eyewash
- A stretcher
- ABC dry powder fire extinguishers

A.12.0 SITE CONTROL MEASURES

Site control measures are typically employed during site activities to prevent or reduce the migration of potentially contaminated materials and to prevent the entry of unauthorized personnel into the work area. Such measures generally include the delineation of zones on the site(s) where prescribed operations occur. As noted throughout this Health and Safety Plan, various field activities will be taking place at several sites on the installation. A three-zone approach will be utilized at each work area for site control.

The exclusion zone will be designated as the specific location where sampling, drilling, test pitting, or other field tasks are to occur. Particularly during drilling and test pitting activities, the Health and Safety Officer (HSO) may opt to barricade the work area by the use of ropes or cones to help control pedestrian traffic and entrance of unauthorized personnel. Each work location will also contain a personnel decontamination station, as part of the contamination reduction zone.

The field activities support zone, where support facilities (i.e., a trailer, site vehicles, if applicable) will be stored, will be in a controlled area on the installation property. Personnel exiting the exclusion zone will be required to go through decontamination, prior to entering this area. The storage of contaminated materials (i.e., samples, sampling equipment, personal protective equipment, etc.) in the support zone will be expressly prohibited.

The coordinator and the HSO will determine the specific location of each zone, while mobilization activities take place. These specific locations will be communicated to other field personnel prior to the commencement of activities on the particular site. This procedure will allow personnel to perform a reconnaissance of the area and determine the optimum location of these zones.

Decision-making criteria for each site set-up and subsequent control measures will take into account the following:

- Physical and topographic features of the site.
- Weather conditions.
- Potential for explosion and flying debris.
- Physical, chemical, toxicological, and other characteristics of the substances present.
- Cleanup activities required.
- Potential for fire.
- Area needed to conduct operations.
- Decontamination procedures.
- Dimensions of the contaminated area.
- Potential for exposure.

For reference purposes, Figure A-4 has been included to illustrate the general layout of the site setup.

A.13.0 CONFINED-SPACE ENTRY PROCEDURES

OSHA Standard 29 CFR 1910.120, entitled Hazardous Waste Operations and Emergency Response (Interim Final Rule) requires that all HASPs address confined-space entries. However, the anticipated activities at Sheppard AFB do not include confined space/limited egress operations. Therefore, establishment of such procedures is not applicable.

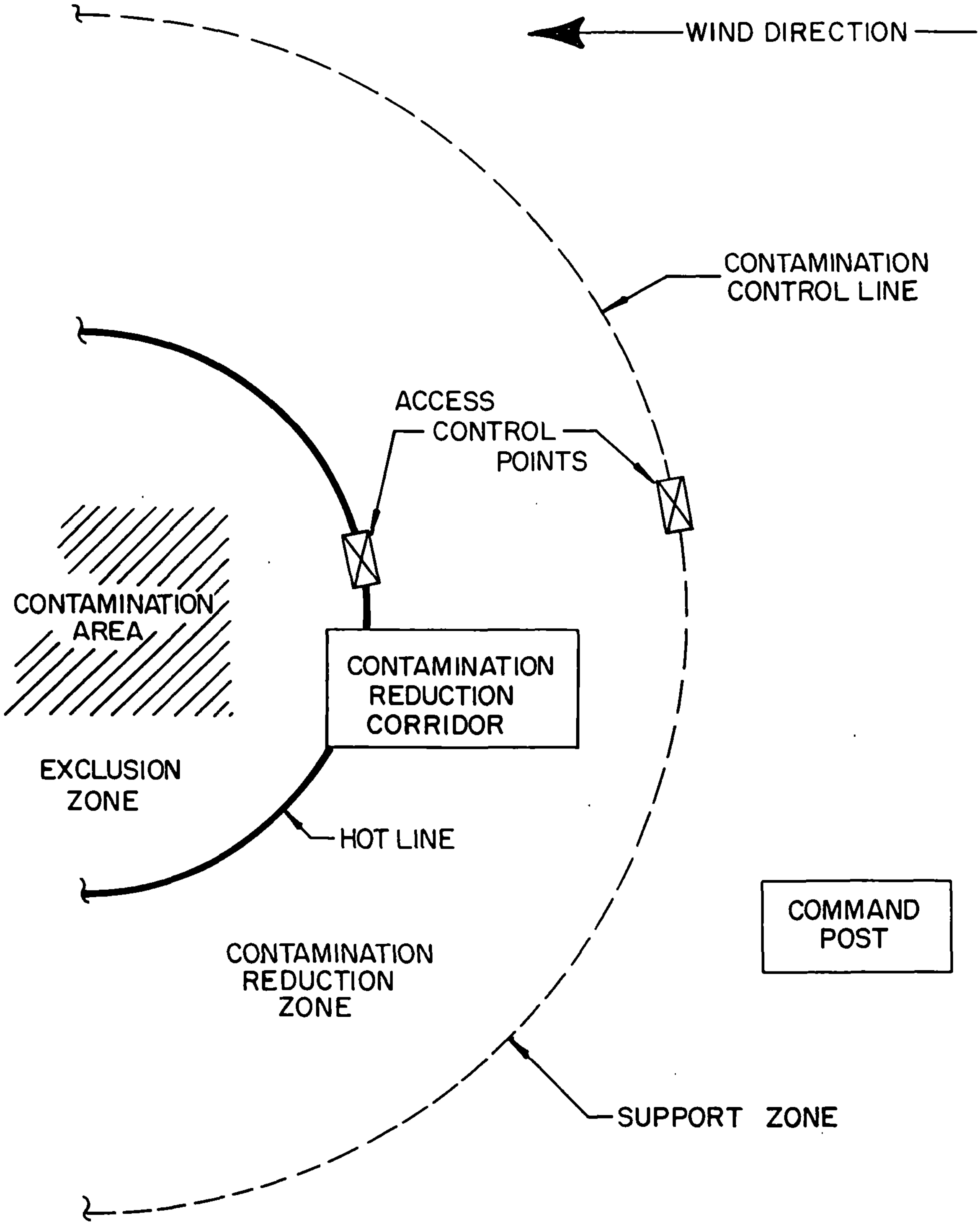

FIGURE A-4 DIAGRAM OF SITE WORK ZONES

NUS CORPORATION

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL PLAN

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)

SHEPPARD AIR FORCE BASE
WICHITA COUNTY, TEXAS

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B.1.0 INTERNAL NUS QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS AND PROCEDURES

B.1.1 Introduction

All of the Quality Assurance Requirements (QARs) and Quality Assurance Procedures (QAPs) described in this appendix are based on Issue C of the NUS Quality Assurance (QA) Manual, dated August 4, 1986. The QA Manual presents a formal program designed to monitor and regulate those activities affecting the quality of work performed.

The NUS QA Program is under the supervision of Marty Booska. Objectives of the program are:

- To maintain the evidentiary value for all data generated.
- To ensure the integrity of site investigations, laboratory analyses, and technical reports.
- To control the activities of subcontractors to ensure that they maintain the same quality standards applied to the NUS activities.

B.1.2 Quality Assurance Requirements and Procedures

Table B-1 references the QAR and QAP sections applicable to Sheppard AFB. Subsequent sections of this appendix summarize the major QA procedures governing laboratory and field activities.

B.2.0 NUS CORPORATION LABORATORY SERVICES GROUP QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The NUS Laboratory Services Group (LSG) is dedicated to providing services in accordance with quality standards and, thus performs all analyses according to accepted QA practices, quality assurance requirements, and quality control procedures specific to U.S. Air Force HAZWRAP projects. These standards are discussed, in detail, in the LSG draft, "Laboratory Quality Assurance Project Plan for USAF HAZWRAP Sites," currently being developed.

TABLE B-1

QUALITY ASSURANCE REQUIREMENTS AND QUALITY ASSURANCE PROCEDURES APPLICABLE TO SHEPPARD AFB TASKS SHEPPARD AIR FORCE BASE, WICHITA COUNTY, TEXAS

	QAR 3.0	QAP 3.2	QAP 3.3	QAR 4.0	QAR 7.0	QAP 11.1	QAP 12.1	QAP 13.1	QAP 13.2	QAP 16.1	QAP 17.1	QAP 17.2	QAP 18.1	QAP 19.1
Project Management	●													●
Subcontract Coordination								●	●					
Mobilization/Demobilization								●	●					
Ground Surveying				●	●			●	●					
Geophysical Investigation				●	●									
Drilling Activities				●				●	●					
Geologic/Hydrogeologic Investigation				●	●			●	●					
Health and Safety Oversight				●	●									
Environmental Sampling				●	●						●	●	●	
Laboratory Analysis										●				
Data Validation							●							
Public Health and Environmental Assessment				●										

Wherever CLP protocols will be utilized, the NUS laboratory will adhere to CLP QA/QC procedures. The deliverables will be those called for in the Statement of Work for Inorganic Analysis, Multi-Media; Multi-Concentration SOW Number 787, Revised December 1987; and the Statement of Work for Organics Analysis, Multi-Media, Multi-Concentrations, revised July 1987, with exceptions described in Section B.2.1.

Appreciating the importance of their function, the laboratories extend their responsibility beyond conforming to Federal, state, and industrial regulations, codes, and standards to subject all work to technical reviews, before results are released outside the corporation.

The laboratories' QA program is used not only to determine the precision and accuracy of the analytical data, but also to confirm (by documentation) all phases of sample handling, data acquisition and transfer, report preparation, and report review. In addition, it provides for storage and retrieval of both samples and data. Because results may be challenged at any time through legal action and social pressures to abate pollution, retrieval of records and data is essential.

The laboratories' QA program dictates that detailed instructions be available for performing all activities affecting the quality of analytical data. The program provides for appropriate management review and approval of all procedures (including revisions) as well as control of procedures to ensure that laboratory personnel have access to them. The LSG Procedures Manual is structured to address all elements of the LSG's Quality Assurance Program. The basic elements of the LSG QA Program are described in the following paragraphs.

Sample Management, Data Review, and Transfer

A computerized system is used for sample check-in, tracking of samples through the laboratory, assignment of laboratory analyses, and sample check-out. The system provides for management review of all laboratory data before issuance of client reports. The review is accomplished on two levels: review of raw data for each analysis and review of the final results to check for consistency and agreement of the results among all parameters. The computer system offers the advantage of fast retrieval of information.

Each analyst records the analytical results and required calculations on his/her analysis assignment sheet. This sheet is reviewed by the Laboratory Supervisor and/or Group Leader prior to its submittal to the data entry clerk. The review process includes a check of the analyst's calculations on both standards and samples as well as an evaluation of the quality control checks. The analytical results are reviewed again by the Laboratory Supervisor.

All quality control data are reviewed monthly by the QA Coordinator. Unfavorable trends in the data are identified and reported to the Operations Supervisor or Laboratory Manager for appropriate action. The senior laboratory staff meets once each month to discuss QA/QC-related problems or policies.

Program Monitoring

A critical element in LSG's QA Program is program monitoring. Program monitoring, a system for regularly auditing all elements of the QA program, is a responsibility of the LSG's Quality Assurance Coordinator (QAC). Each month, a sufficient number of program elements are reviewed to check for compliance with established procedures. Any deficiencies are reported to management so that corrective actions can be taken. The identified non-conformances are again reviewed by the QAC to ensure that deficiencies have been corrected.

Recordkeeping

Because detailed documentation is needed to support the validity of analytical work, a specific procedure details the requirements for laboratory recordkeeping. The procedure not only describes how to keep records, but also how records are to be identified and stored.

Security

A laboratory security procedure deals with the steps to be taken to maintain the integrity of samples as well as laboratory records. The security system is a way of minimizing the possibility of tampering so that laboratory data can be supported or the analyses recreated, if necessary.

Cleaning and Housekeeping

The nature of laboratory work requires that adequate steps are taken to avoid contamination of samples. Improperly cleaned glassware, equipment, and instrumentation can contribute to unreliable data; therefore, the laboratory has developed specific steps to be followed.

Sample Preservation, Collection, and Storage

The LSG QA Program includes specific procedures for sample preservation, collection, and storage. The procedures are based on the recommendations contained in the appropriate governing publications. Included in the procedures are descriptions of the preservatives to be used, the types of records to be maintained, and the storage requirements.

Analytical Procedures

To ascertain that the laboratory analyses are performed using proper techniques, a section of the LSG Procedures Manual is devoted to laboratory methods. A copy of each laboratory method is centrally located and readily available for the analysts' use. All methods are based on accepted government and industry standards and contain the following information:

- ***Scope***

  A description of the scope or applicability of the procedure.

- ***Principle***

  A brief description of the steps to be taken and/or the theory involved in the laboratory analysis.

- ***Interferences***

  A description of known interfering agents which would cause difficulty in performing the laboratory analysis or would lead to erroneous results.

- ***Apparatus***

  A list or description of equipment required to perform the laboratory analysis.

- ***Reagents***

  A list of the reagents required, a description of the steps involved in preparing the reagents, and instructions on storage requirements and retention times.

- ***Procedure (Instructions)***

  An enumeration of the sequence of activities to be followed. The topics include: sample preparation or pretreatment; sample storage requirements; instrument set-up, standardization or calibration; sample analysis; calculations; and glassware cleaning procedures. The procedure includes any precautions, explanations, or clarifications as needed to properly perform the analysis. These include: safety precautions; the frequency of standardization required; the acceptance criteria or procedures for determining the acceptability of standard curves; clarifications of special techniques critical to the analysis; and how the analyst determines the reliability of sample results based on the standard curves.

- ***Quality Control Requirements***

  A list of the quality control (QC) checks to be performed and the acceptance criteria used to evaluate the QC data.

- ***References***

  A list of the publications from which the information was derived in preparing the laboratory method. As a rule, laboratory methods are derived from the following publications: <u>Standard Methods for the Examination of Water and Wastewater</u>, American Public Health

Association; Annual Book of Standards, American Society for Testing and Materials; Methods for Chemical Analysis of Water and Waste, Environmental Protection Agency; Test Methods For Evaluating Solid Waste, SW-846, Environmental Protection Agency (Third Edition, 1986); and Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Environmental Protection Agency. Editions used are those currently specified in the Federal Register.

Personnel Training

A system has been developed for training within the LSG. The program describes: who is responsible for quality assurance, laboratory skills, analytical methods, and special projects training; the required frequencies for training personnel; and the records to be retained as evidence of training.

Analytical Instruments and Test Equipment

A formal system is used for control of analytical instruments and test equipment used for calibrations. The procedure details the steps to be taken to calibrate and standardize instruments to ensure that analytical data are accurate. All calibrations are traceable to the National Bureau of Standards. This calibration traceability is reported on an Instrument Calibration Record. Calibration frequencies are determined using the guidelines established by the manufacturers. The status of all major laboratory equipment requiring calibration is regularly updated. All inactive equipment is segregated from active equipment and appropriately labeled with an inactive sticker, indicating that the instrument must be recalibrated before use.

Procurement Control

A procurement procedure identifies the methods to be used to document and control the purchase of materials, parts, and services. The procedure includes provisions for identifying the quality of laboratory chemicals and equipment, evidence of management approval of procured items, inspection of shipments for compliance to requirements, and isolation of nonconforming items to be returned to vendors. The quality of all glassware, reagents, and equipment must conform to the requirements specified in the latest edition of the EPA Handbook of Analytical

Quality Control in Water and Wastewater Laboratories, the Federal Register, or other regulatory agency publications.

Nonconformance and Corrective Action Control

Incorporated in the LSG's QA Program is a system for identifying, reporting, and correcting nonconformances. A nonconformance is defined as any deficiency which renders the quality of analytical work unacceptable or indeterminable. Deviations from the LSG's QA Program or acceptance criteria are considered nonconformances and require remedial action. The procedure includes provisions for stopping all or a portion of any project until a satisfactory resolution to problems has been achieved.

Quality Control

The quality of analytical data is monitored through the use of quality control procedures. The procedures specify what measures are to be taken to determine the validity of laboratory analyses. These include the analysis of method blanks, reagent blanks, daily standard checks, method duplicates, matrix spikes, and surrogate spikes. Blanks are run, together with the actual samples, to check for possible contamination.

General QC procedures are described on the following pages. QC information specific to the actual analyses proposed for Sheppard AFB can be found in "Quality Control Procedures for Organic Analyses" and "Quality Control Procedures for Inorganic Analyses", which follow this section.

- ***Precision***

  Precision refers to the reproducibility of results. At NUS, these results are obtained from actual samples, not from reference standards. The samples selected cover a range of concentrations and a variety of interfering materials.

  Every twentieth sample, or one sample in each day's run for a specific parameter, is determined in duplicate using different aliquots, when practical.

The precision of duplicate measurements is expressed as relative percent difference (RPD), which is the absolute value of the range between the duplicate results divided by the mean, expressed as percent. The range or RPD is calculated as follows:

$$\text{Range} = \left| OR - DR \right|$$

$$\text{RPD} = \left| \frac{OR - DR}{1/2(OR + DR)} \right| \times 100\%$$

Where:

OR = original sample result
DR = duplicate sample result

The control limits for precision are set at three times the standard deviation of a series of RPD or range values, calculated as follows:

$$\text{Mean } (\overline{X}) = \frac{1}{n} \sum_{i=1}^{n} Xi$$

$$\text{Standard Deviation (S)} = \sum_{i=1}^{n} (Xi - \overline{X})^2 / (n - 1)$$

Control Limit = 3S

Where:

X = RPD or range values
n = number of x values

- ***Accuracy***

Accuracy is the comparison between observed and known values. Actual samples, if possible those used for precision data, are used for obtaining accuracy data. An aliquot of standard solution is added to the sample. A theoretical result is then calculated and compared to the actual spiked sample.

Accuracy is expressed as matrix spike recovery (MSR) using the following equation:

$$MSR = \frac{AR}{TR} \times 100\%$$

Where:

AR = actual matrix spike result
TR = theoretical matrix spike result

Control limits for accuracy are set at the mean plus or minus three times the standard deviation of a series of MSR values. The mean and standard deviation are calculated as for precision, except that X represents MSR values.

- ***Quality Control Data Monitoring***

The laboratory uses a computerized system for reporting quality control data. The analysts enter the duplicate and spike results into the computer. The computer calculates precision and accuracy and tells the analyst whether the data is in control. Daily generation of quality control data allows the QA staff access to problem data on a timely basis to ensure that corrective action is taken before sample results are reported.

B.2.1 U.S. Air Force Quality Assurance (QA) Requirements

Martin Marietta Energy Systems has proposed standard quality assurance (QA) requirements for all Air Force projects in the "Sampling and Chemical Analysis Quality Assurance Requirements" guide for U.S. Air Force (HAZWRAP) projects, second revision, June 1988. This guide defines three QA levels which are based on the characteristics of the site and the data quality objectives and delivery requirements. A brief description of the intent for each of the three QC levels is as follows:

- Level D: QC to be used when the site, usually near a populated area, is on or soon to be added to the NPL and litigation is likely.
- Level C: QC to be used when the site is near a populated area, but is not on the NPL and litigation is unlikely.
- Level E: QC to be used when the site is in an unpopulated area, is not on the NPL, and litigation is very unlikely. This level is also approprate for waste samples from underground storage tanks.

NUS proposes to follow the proposed guidelines as found in the "Air Force QA/QC Guide" with the following exceptions or clarifications:

- For volatiles and semi-volatiles by gas chromatography/mass spectrometry (GC/MS) and pesticides/PCBs by gas chromatography, Contract Laboratory Program (CLP) methods will be used for all QC levels.
- The use of CLP methods will NOT include qualitative and semi-quantitative analyses from tentatively identified compounds (TICs) by GC/MS for QC Level D volatiles and base-neutral/acids, since the site history indicates only the disposal of specific petroleum-based contaminants (i.e., waste oil, fuel, etc.).
- CLP deliverables for QC Level D will not include data on diskette. Diskette deliverables can be provided at additional charge.
- Sample bottle cleaning procedures will follow the requirements as described in the approved laboratory methods from 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants."

A general summary of the QC and reporting requirements for U.S. Air Force projects is found in Table B-2.

TABLE B-2

QC AND REPORTING REQUIREMENTS
U.S. AIR FORCE

QC Level	Laboratory Methods	QC Checks	Acceptance Criteria	Blanks	Deliverables	Batch Size	Holding Times	Sample Bottle Cleaning(2)
D	CLP (7/87 revision)	CLP	CLP	No subtraction from sample results	CLP (reporting forms modified, where appropriate, when non-TCL parameters are requested)	Per CLP	Per CLP	Per EPA-approved procedures
C	CLP for volatiles, base-neutral and acid extractables, and pesticides/ PCBs. EPA-approved for all others	See Table B-4	See Table B-4	No subtraction from sample results	See Table B-5	Number of samples of similar matrix processed simultaneously through preparation and analysis	Per CLP for TCL, per 40 CFR 136 for all other parameters(1)	Per EPA-approved procedures

(1) These holding times are applied to all sample matrices.

(2) Bottle cleaning procedures can be as specified in the laboratory methods, as described in the "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," USEPA.

QC Level D

U.S. Air Force QA Level D will be used to analyze samples from Sheppard Air Force Base for Target Compound List (TCL) volatiles, base neutral/acid extractables, TCL pesticides/PCBs, organophosphorus pesticides, and chlorinated herbicides. The reference methods that will be used to perform the analyses are summarized on Tables B-3 through B-6.

The methods for volatiles, base neutral/ acid extractables, and pesticides/PCBs are found in "Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration," July 1987. The reference document for priority pollutant metals is "Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration," SOW 787, July 1987.

Level D analyses will include the QA/QC, chain-of-custody, and delivery requirement (excluding diskette) as described in the CLP Statement of Work (SOW) referenced above.

QC Level C

Some of the analyses that will be performed for Sheppard Air Force Base are not appropriate for Level D QC. These miscellaneous analyses will be performed using QC Level C. A summary for the analyses of the required parameters and the reference methods is found on Tables B-3 through B-6.

For Level C, NUS will use its routine control limits and acceptance criteria, except for metals, where CLP limits will be used to evaluate precision and accuracy. When sufficient data are available, control limits will be calculated as previously described in the section of the generic QA work plan entitled, "Quality Control (QC)."

QC requirements and acceptance criteria for QC Level C are presented in Table B-7. QC delivery requirements for Level C are summarized in Table B-8.

B.3.0 FIELD ACTIVITIES QA/QC PLAN

This field activities QA/QC plan provides a mechanism for ensuring that the integrity, reproducibility, and accuracy of field data is maintained.

TABLE B-3

REFERENCE METHODS USED FOR PERFORMING ANALYSES
SHEPPARD AIR FORCE BASE, WICHITA COUNTY, TEXAS

Parameter	Reference Method	Air Force QC Level
TCL Volatiles	CLP (without TICs)	D
Priority Pollutant Base Neutral and Acids (with TICs)	CLP (without TICs)	D
TCL Pesticides/PCBs	CLP	D
Priority Pollutant Metals		C
- Antimony	EPA 204.2	
- Arsenic	EPA 206.2	
- Beryllium	EPA 200.7	
- Cadmium	EPA 200.7	
- Chromium	EPA 200.7	
- Copper	EPA 200.7	
- Lead	EPA 239.2	
- Mercury	EPA 245.1, CLP 245.5	
- Nickel	EPA 200.7	
- Selenium	EPA 270.2	
- Silver	EPA 272.1	
- Thallium	EPA 279.2	
- Zinc	EPA 200.7	
- Cyanide	EPA 335.2	

TABLE B-3
REFERENCE METHODS USED FOR PERFORMING ANALYSES
SHEPPARD AIR FORCE BASE, WICHITA COUNTY, TEXAS
PAGE 2

Parameter	Reference Method		Air Force QC Level
	Water	Soil/ Sediment	
Petroleum Hydrocarbons	EPA 418.1	SW3550(1)/ EPA 418.1	C
Sulfate	SM 426C(2)		C
Phosphate	EPA 365.2		C
Nitrate	EPA 352.1		C
Nitrite	EPA 354.1		C
Fluoride	SM 413B(2)		C
Chloride	SM 407B(2)		C
Bromide	EPA 320.1		C
Total Dissolved Solids	EPA 160.1		C
Cation Exchange Capacity (CEC)		EPA - SW9081	C
Gross Alpha	EPA 900.0	EPA 900.0	C
Gross Beta	EPA 900.0	EPA 900.0	C
Radium-226	EPA 903.0(3)		C
Radium-228	EPA 904.0(3)		C
Gamma Spectrometry	EMSL(4)	EMSL	C

(1) SW refers to "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods," SW-846, 3rd Edition.
(2) SM refers to "Standard Methods for the Examination of Water and Wastewater," 15th Edition, APHA-AWWA-WPCF.
(3) EPA (radiochemistry parameters) refers to "Prescribed Procedure for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032.
(4) EMSL refers to "Radiochemical Analytical Procedures for Analysis of Environmental Samples," EMSL-LV-0539-17.

TABLE B-4

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR VOLATILES(1) SHEPPARD AIR FORCE BASE

Volatiles	CAS Number	Quantitation Limits(2)	
		Water ug/L	Low Soil/Sediment(3) ug/Kg
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl Chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene Chloride	75-09-2	5	5
Acetone	67-64-1	10	10
Carbon Disulfide	75-15-0	5	5
1,1-Dichloroethene	75-35-4	5	5
1,1-Dichloroethane	75-34-3	5	5
1,2-Dichloroethene (total)	540-59-0	5	5
Chloroform	67-66-3	5	5
1,2-Dichloroethane	107-06-2	5	5
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	5	5
Carbon Tetrachloride	56-23-5	5	5
Vinyl Acetate	108-05-4	10	10
Bromodichloromethane	75-27-4	5	5
1,2-Dichloropropane	78-87-5	5	5
cis-1,3-Dichloropropene	10061-01-5	5	5
Trichloroethene	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-Trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
trans-1,3-Dichloropropene	10061-02-6	5	5
Bromoform	75-25-2	5	5
4-Methyl-2-pentanone	108-10-1	10	10
2-Hexanone	591-78-6	10	10
Tetrachloroethene	127-18-4	5	5
Toluene	108-88-3	5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5

TABLE B-4

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR VOLATILES(1)
SHEPPARD AIR FORCE BASE
PAGE TWO

Volatiles	CAS Number	Quantitation Limits(2)	
		Water ug/L	Low Soil/Sediment(3) ug/Kg
Chlorobenzene	108-90-7	5	5
Ethyl Benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Xylenes (total)	1330-20-7	5	5

(1) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

(2) Specific quantitation limits are highly matrix-dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(3) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment (calculated on a dry-weight basis as required by the contract) will be higher.

TABLE B-5

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR PESTICIDES/PCBS(1) SHEPPARD AIR FORCE BASE

Volatiles	CAS Number	Quantitation Limits(2)	
		Water ug/L	Low Soil/Sediment(3) ug/Kg
alpha-BHC	319-84-6	0.05	8.0
beta-BHC	319-85-7	0.05	8.0
delta-BHC	319-86-8	0.05	8.0
gamma-BHC (Lindane)	58-89-9	0.05	8.0
Heptachlor	76-44-6	0.05	8.0
Aldrin	309-00-2	0.05	8.0
Heptachlor epoxide	1024-57-3	0.05	8.0
Endosulfan I	959-98-8	0.05	8.0
Dieldrin	60-57-1	0.10	16.0
4,4'-DDE	72-55-9	0.10	16.0
Endrin	72-20-8	0.10	16.0
Endosulfan II	33013-65-9	0.10	16.0
4,4'-DDD	72-54-8	0.10	16.0
Endosulfan sulfate	1031-07-8	0.10	16.0
4,4'-DDT	50-29-3	0.10	16.0
Methoxychlor	72-43-5	0.5	80.0
Endrin ketone	53494-70-5	0.10	16.0
alpha-Chlordane	5103-71-9	0.5	80.0
gamma-Chlordane	5103-74-2	0.5	80.0
Toxaphene	8001-35-2	1.0	160.0
Aroclor-1016	12674-11-2	0.5	80.0
Aroclor-1221	11104-28-2	0.5	80.0
Aroclor-1232	11141-16-5	0.5	80.0
Aroclor-1242	53469-21-9	0.5	80.0
Aroclor-1248	12672-29-6	0.5	80.0
Aroclor-1254	11097-69-1	1.0	160.0
Aroclor-1260	11096-82-5	1.0	160.0

TABLE B-5

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR PESTICIDES/PCBS(1)
SHEPPARD AIR FORCE BASE
PAGE TWO

Notes:

(1) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 15 times the individual Low Soil/Sediment CRQL.

(2) Specific quantitation limits are highly matrix-dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(3) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment (calculated on a dry-weight basis as required by the contract) will be higher.

TABLE B-6

PRIORITY POLLUTANT ORGANICS (625/8270)
(GAS CHROMATOGRAPHY/MASS SPECTROSCOPY)
SHEPPARD AIR FORCE BASE

Acid Compounds (625/8270)		Base/Neutral (625/8270)	
1A	2-Chlorophenol	1B	Acenaphthene
2A	2,4-Dichlorophenol	2B	Acenaphthylene
3A	2,4-Dimethylphenol	3B	Antracene
4A	4,6-Dinitro-o-cresol	4B	Benzidine
5A	2,4-Dinitrophenol	5B	Benzo (a) anthracene
6A	2-Nitrophenol	6B	Benzo (a) pyrene
7A	4-Nitrophenol	7B	3,4-Benzofluoroanthene
8A	p-Chloro-m-cresol	8B	Benzo (ghi) perylene
9A	Pentachlorophenol	9B	Benzo (k) fluoranthene
		10B	bis (2-Chloroethoxy) methane
		11B	bis (2-Chloroethyl) ether
		12B	bis (2-Chloroisopropyl) ether
		13B	bis (2-Ethylhexyl) phthalate
		14B	4-Bromophenyl phenyl ether
		15B	Butylbenzyl phthalate
		16B	2-Chloronaphthalene
		17B	4-Chlorophenyl phenyl ether
		18B	Chrysene
		19B	Dibenzo (a,h) anthracene
		20B	1,2-Dichlorobenzene
		21B	1,3-Dichlorobenzene
		22B	1,4-Dichlorobenzene
		23B	3,3'Dichlorobenzidine
		24B	Diethylphthalate
		25B	Dimethyl phthalate
		26B	Di-n-butyl phthalate
		27B	2,4-Dinitrotoluene
		28B	2,6-Dinitrotoluene
		29B	di-n-octyl phthalate
		30B	1,2-Diphenylhydrazine (as axobenzene)
		31B	Fluoroanthene
		32B	Fluorene
		33B	Hexachlorobenzene
		34B	Hexachlorobutadiene
		35B	Hexachlorocyclopentadiene
		36B	Hexachloroethane
		37B	Indeno (1,2,3-cd) pyrene
		38B	Isophorone
		39B	Naphthalene
		40B	Nitrobenzene
		41B	N-nitrosodimethylamine
		42B	N-nitrosodi-n-propylamine

TABLE B-7

QUALITY CONTROL REQUIREMENTS FOR QC LEVEL C

Parameters	QC Requirement	Acceptance Criteria
Petroleum hydrocarbons, common anions, and miscellaneous wet chemistry	Matrix spike/matrix spike duplicate - performed prior to sample preparation at a frequency of 1 in 20 samples(1)	Internal control limits
Metals and cyanide	Duplicate and predigestion spike at a frequency of 1 in 20 samples	CLP limits
All parameters	Method blank - 1 per batch	Less than the reporting limit(2)
All parameters	Blank spike - 1 per batch(3)	Internal limits - recovery plotted on control charts
Metals and cyanide	Initial and continuing calibration per CLP protocol	CLP criteria
Common anions, petroleum hydrocarbons, CEC	3-point initial calibration followed by continuing calibration every 12 hours; instrument blank after calibration	Internal limits
Radiologicals	Spiked sample or standards analysis - 1 per batch	Internal limits
Radiologicals, TDS, CEC	Duplicate analysis - 1 in 20 samples	Internal limits RPD

(1) Sample limitations will prevent performing MS/MSD analyses for oil and grease and petroleum hydrocarbons on water samples.

(2) If the samples do not contain the blank contaminants, the samples do not need to be reanalyzed. If the samples and blank contain the analyte in question, the samples from that batch should be reanalyzed. If there is insufficient samples for reanalysis, the data must be flagged.

(3) The blank/spike for water samples is prepared by spiking a standard from a different source than is used for calibration into deionized water. For soil samples, a standard is to be spiked into a control material of similar matrix (obtained from EPA, NBS, or other outside source). The blank/spike for various parameters will consist of the following:

- Pesticides - at least 2 pesticide compounds
- PCBs - at least 1 PCB compound
- Wet chemistry parameters - single spike/method
- ICP analyses - at least 3 metals
- Flame and graphite furnace analyses - all elements analyzed

TABLE B-8

DELIVERABLES FOR QC LEVEL C

Method Requirements	Deliverables
LEVEL C - METALS(1)	
Sample results with CLP flags	CLP Form I
Initial and continuing calibration	CLP Form II, Part I only
Post-digestion blank. Frequency of 10 percent	CLP Form III
ICP interference check sample	CLP Form IV
Matrix spike recovery data. One per 20 samples of similar matrix of 1 per sampling event (whichever is more frequent)	CLP Form V, Part I
Post-digestion spike recovery for ICP metals (if pre-digestion spike recovery exceeds CLP limits)	CLP Form V, Part II
Post-digestion spike recoveries for graphite furnace metals	Summary. No specific format
Duplicates (pre-digestion). One per 20 samples of similar matrix or one per sampling event (whichever is more frequent)	CLP Form VI
Method blank spike. One per batch	Control chart (if sufficient data are available) or recoveries
Method of standard addition for graphite furnace metals using the decision process as defined on page E-14 of the CLP protocol	CLP Form VIII
Holding times	CLP Form X
LEVEL C - WET CHEMISTRY(1)	
Method blank spike. One per batch	Control chart (if sufficient data are available) or recoveries
Method blank. One per batch	Report result. No specific format
Sample results	Report results. No specific format
Matrix spike/matrix spike duplicate or calibration data (for petroleum hydrocarbons in water)	Report results. No specific format
Continuing calibration	Report percent RSD or percent difference from initial calibration. No specific format
LEVEL C - RADIOLOGICALS	
Sample results	Report result. No specific format
Method blank. One per batch	Report result. No specific format
Method blank spike. One per batch	Control chart (if sufficient data are available) or recoveries
Duplicate analysis results	Report results. RPD. No specific format
Sample spike or standards analysis	Report results. No specific format

(1) No raw data are required.

B.3.1 Cleaning, Shipping, and Storage of Sample Containers

All containers to be used for sampling are new. Upon receipt from the manufacturer, sample containers to be used for BN/As and pesticides are placed in a muffled oven at 400°C by LSG. Vials to be used for VOA analyses are likewise prepared, at 105°C, by LSG. Following the heat treatment, all containers are sealed and packaged in styrofoam "peanuts." The sample packages will be shipped to Sheppard AFB by common carrier. Upon arrival, the packages will be inspected for damage or tampering. The sample containers will then be stored in the NUS field office and used as needed. Additional cleaning of sample containers will not be required.

B.3.2 Sample Documentation

Proper documentation of each field event is critical. NUS will document all pertinent information, data, observations, problems encountered, and methodologies to provide the following:

- Verification that all applicable QA procedures were followed.
- All the information that would be needed to conduct a complete resampling effort, consistent with prior sampling events.

Various forms of documentation (i.e., Sections B.3.2.1 through B.3.2.6) will be used to ensure that field data are accurate and retrievable and that sample integrity is maintained.

B.3.2.1 Sample Labels

Durable labels will be affixed to every sample container to help prevent misidentification of samples. Sample labels will contain the following information:

- Site name.
- Sample number (see Section B.3.4 for numbering system).
- Date and time of collection.
- Type of analysis.

B.3.2.2 Field Logbook

All pertinent information regarding field activities will be entered into a bound logbook(s) with consecutively numbered pages. Entries into the logbook(s) will include the following information:

- Date and time of site entry and exit.
- Personnel on site and their responsibilities.
- Weather conditions.
- Field observations.
- Date, time, depth, location, number, and description of each sample collected.
- Sample collection methodology.
- Sampling Plan changes or deviations.
- Methods of decontamination.
- Health and safety procedures and observations.
- Sample management procedures.
- Maps, sketches, and site descriptions.
- Field measurements such as organic vapor readings, pH, and conductivity.
- Calibration records for field equipment.
- Photography log.

B.3.2.3 Geologic Data Sheets

Geologic data sheets (i.e., boring logs, well completion logs, and ground-water monitoring well data) will complement the field data contained in the logbook(s). See Figures B-1, B-2, and B-3 for examples of the geologic data sheets to be used.

B.3.2.4 Chain-of-Custody Record

Sample chain-of-custody will be maintained during all field operations to ensure that unauthorized tampering of samples does not occur. Specific actions taken to ensure that sample chain-of-custody is maintained will be recorded in the field logbook (e.g., locking an unattended vehicle containing samples). In addition, a chain-of-custody record will be generated for each batch of samples shipped within

NUS CORPORATION

FIGURE B-1 FIELD LOG OF BORING

SHEET ______ OF ______

LOCATION OF BORING:	PROJECT:	BORING NO.
		TOTAL DEPTH:
	JOB NO.:	LOGGED BY:
	PROJ. MGR.:	EDITED BY:

DRILLING CONTRACTOR:			
DRILL RIG TYPE:			
DRILLERS NAME:			
SAMPLING METHODS:			
HAMMER WT.:	DROP:		
STARTED, TIME:	DATE:		
COMPLETED, TIME:	DATE:		
BORING DEPTH (ft.)			
CASING DEPTH (ft.)			
WATER DEPTH (ft.)			
TIME:			
DATE:			
BACKFILLED, TIME:	DATE:	BY:	
SURFACE ELEV.:	DATUM:		
CONDITIONS:			

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)				DEPTH IN FEET	GRAPHIC LOG
										1	
										2	
										3	
										4	
										5	
										6	
										7	
										8	
										9	

FIGURE B-2

FIELD WELL COMPLETION FORM

JOB NAME:

JOB NUMBER: | PROJECT MANAGER:

LOGGED BY: | EDITED BY:

WELL NAME: | DATE:

DRILLING COMPANY:

EQUIPMENT: ☐ ______ INCH HOLLOW STEM AUGER | DRILLER:

☐ ______ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING:

DEVELOPMENT

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐CLEAR ☐SLIGHTLY CLOUDY ☐MOD. TURBID ☐VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐GROUND SURFACE ☐TANK TRUCK ☐STORM SEWERS ☐STORAGE TANK ☐DRUMS ☐OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

______ SACKS OF ______ SAND

______ SACKS OF ______ CEMENT

______ GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

______ POUNDS OF BENTONITE PELLETS

______ FEET OF ______ INCH PVC BLANK CASING

______ FEET OF ______ INCH PVC SLOTTED SCREEN

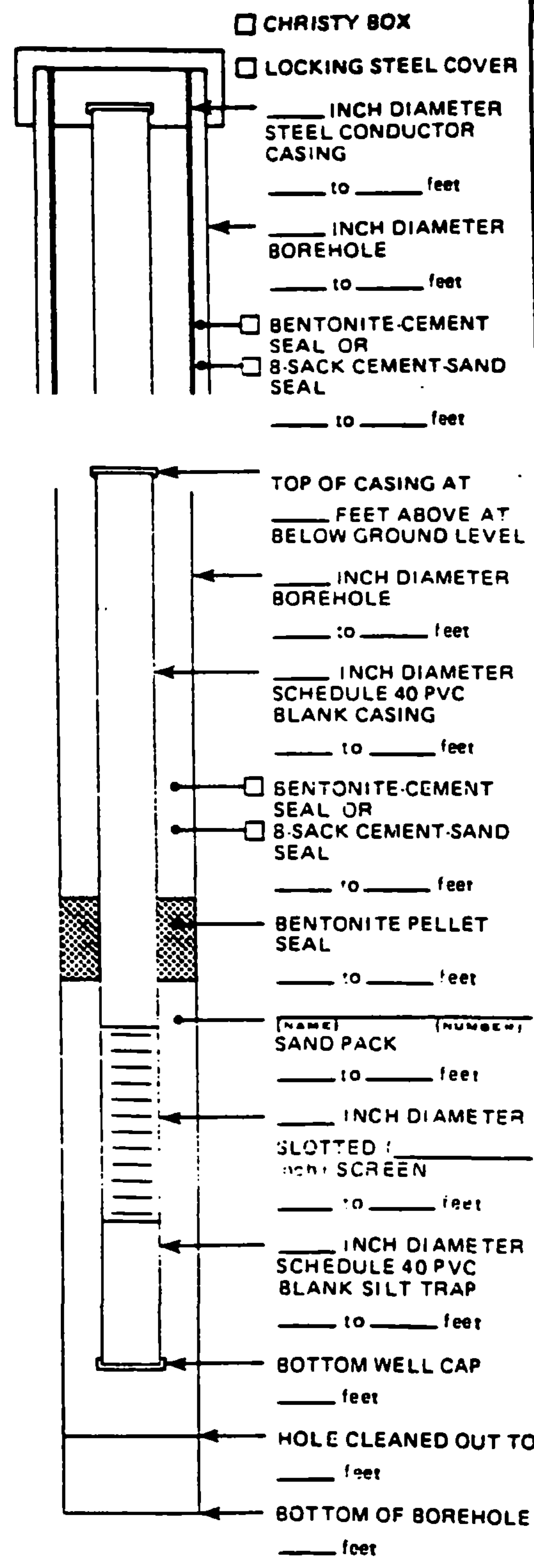
______ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

______ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐NO ☐YES

NAME ______

WELL COVER USED: ☐LOCKING STEEL COVER ☐CHRISTY BOX ☐OTHER ______



NOT TO SCALE

ADDITIONAL INFORMATION: ______

FIGURE B-3
GROUND-WATER MONITORING DATA SHEET

Monitoring Well No. ______________________

Stick-Up (feet) ______________________

Static Water Level From Top of Casing (feet) ______________________

Total Depth of Well (feet) ______________________

Height of Water Column ______________________

Inside Diameter of Well (inches) ______________________

Well Volume (gallons) ______________________

PURGING NOTES:

Date _____ Time _____ pH _____ SC _____ Temp. °C _____

Purging Method ______________________

Estimated Discharge Rate ______________________

SAMPLE COLLECTION NOTES:

Date Sampled ______________________

Time ______________________

the same cooler. The chain-of-custody record accompanying each shipment of samples will serve to provide documentation for tracking each sample possession. See Figure B-4 for an example of the chain-of-custody record to be used. This record will contain the following:

- Site name
- Sample numbers
- Date and time of collection
- Number of containers
- Analysis requested
- Signature of person involved in chain of possession

B.3.2.5 Custody Seal

Custody seals will be placed on both sides of each shipping cooler lid to ensure that the samples have not been disturbed during transportation. The seals will include the sampler's name and the date.

B.3.2.6 Sample Packaging and Shipping

Packaging and shipping procedures will be based on the following definitions:

- Low-concentration samples are samples collected in an area surrounding a known spill or dump site. They are considered to contain relatively low pollutant levels.

- High-concentration samples are samples collected directly from waste piles, drums, tanks, chemical spills, or direct discharges in instances where there is little or no evidence of environmental dilution and where the sample is suspected to contain greater than 15 percent of any individual chemical contaminant.

The following shipping procedures comply with Department of Transportation (DOT) regulations (49 CFR Section 171-179).

FIGURE B-4

NUS CORPORATION | **CHAIN OF CUSTODY RECORD**

PROJECT NO	SITE NAME

SAMPLERS (SIGNATURE):

STATION NO	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO OF CONTAINERS							REMARKS

RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE)
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE)
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE/TIME:	REMARKS:	

All low-concentration samples should be packaged and shipped as follows:

1. Place each sample container in a 2-mil plastic bag and seal the bag.

2. Place the container in a DOT-approved cooler.

3. Fill the cooler one quarter full of packing material (e.g., vermiculite or perlite).

4. Fill several plastic bags with ice chips, seal the bags, and pack the ice bags around the samples.

5. Fill the cooler with packing material.

6. Place all paperwork going to the laboratory (i.e., chain-of-custody record) inside a plastic bag and tape it to the inside of the cooler lid.

7. Close the cooler, seal it with strapping tape, and place at least one custody seal over the front edge of the cooler and one over the back edge.

8. Deliver the cooler to Federal Express (or other express carrier) using a standard airbill.

All high-concentration samples should be packaged and shipped as follows:

1. Leave at least 10 percent head space for sample jars, and ensure that the jars are not kept in an environment exceeding 130°F. If head space will affect sample integrity, place the full sample container inside a larger container so that the latter is filled to a maximum of 90 percent of its capacity.

2. Place each sample container in a plastic bag at least 2 mil thick and seal the bag.

3. Place each container in a separate paint can, and fill the can with packing material.

4. Place the lid on each paint can; seal with metal clips or tape.

5. Place arrows on the cans indicating which end should be up.

6. Write the proper shipping name and identification number on each can. Note: When the nature of the sample is uncertain, it should be designated as either flammable liquid or flammable solid. For flammable liquids, the proper shipping name is Flammable Liquid, Not Otherwise Specified (N.O.S.), and the Identification Number is UN1993. For flammable solids, the proper shipping name is Flammable Solid, N.O.S., and the Identification Number is UN1325. Proper shipping names of specific substances can be found in the DOT hazardous materials table (49 CFR Part 172.101).

7. Place the cans upright in a DOT-approved cooler and fill the cooler with packing material. If space permits, the cans can be stacked one on top of another.

8. Place all paperwork going to the lab (i.e., chain-of-custody record) inside a plastic bag and tape it to the inside of the cooler lid.

9. Close the cooler, seal it with strapping tape, and place at least one custody seal over the front edge of the cooler and one over the back edge.

10. Write the proper shipping name and identification number on the top and all four sides of the cooler.

11. Place a "This End Up/Inside Packages Comply with Prescribed Regulations" label on the top and all four sides of the cooler, with upward pointing arrows on the sides of the cooler.

12. Place "Danger" and either "Flammable Liquid" or "Flammable Solid" labels on the top and all four sides of the cooler.

13. Write the addressee and addressor on the top of the cooler.

14. "Cargo Aircraft Only" labels must be used if the net quantity of sample in each outer container is greater than one quart (for "Flammable Liquid, N.O.S.") or 25 pounds (for "Flammable Solid, N.O.S.").

15. High-hazard airbills should be used for shipping. The "Shipper Certification for Restricted Articles" section should be filled out as follows:

- Number of packages - number of coolers

- Proper shipping name

  - Flammable Solid, N.O.S.
  - Flammable Liquid, N.O.S.

- Classification

  - Flammable Solid
  - Flammable Liquid

- Identification number (respectively)

  - UN1325
  - UN1993

- Net quantity per package - number of containers per cooler.

- Radioactive materials section - leave blank.

- Passenger/cargo aircraft - up to 25 pounds of flammable solid per cooler can be shipped on a passenger aircraft. Up to 1 quart of flammable liquid per cooler can be shipped on a passenger aircraft and up to 10 gallons of flammable liquid per cooler can be shipped on a cargo aircraft.

- Print your name and title.

- Give an emergency telephone number where you can be reached within the next 24-48 hours.

- Sign the airbill.

16. Deliver the cooler, along with its high-hazard airbill, to Federal Express (or other express carrier).

Table B-9 presents methods of sample preservation, sample containers, and holding times to be employed.

B.3.3 QA/QC Samples

Four types of QA/QC samples will be collected as part of this project:

- Splits and Duplicates - Not more than 5 percent of all samples will be tested in duplicate as part of an NUS internal laboratory QA/QC check. The Sheppard AFB Environmental Coordinator will select which samples will be taken as splits.

- Trip Blanks - Trip blanks will be collected to check for cross-contamination between samples during shipping. Each bottle will be filled with deionized water, transported to the site, handled in the same manner as a sample, and returned to the laboratory for analysis. One set of trip blanks will be shipped in each cooler containing VOAs. Trip blanks will be analyzed for all applicable VOAs.

- Rinsate Blanks - Rinsate blanks are used to check the effectiveness of cleaning procedures used on sampling equipment. Rinsate blanks will be collected from selected pieces of sampling equipment. After the equipment is cleaned, deionized water will be poured through or over it. The rinsate will then be collected in appropriate containers. One rinsate blank will be collected per day. The sampling equipment to be used for the collection process will vary daily. Only those samples collected every other day will be shipped for laboratory analysis. The remaining samples will be

TABLE B-9

WATER SAMPLES
METHODS OF PRESERVATION, SAMPLE CONTAINERS, AND HOLDING TIMES
SHEPPARD AIR FORCE BASE, WICHITA COUNTY, TEXAS

MATRIX: WATER

Parameter	Preservation	Sample Container	Sample Container Size	Holding Time
Volatile Organics, TCL (no TICs)	Cool, 4°C	G Teflon-lined septum	2-40 ml	10 days
Antimony Beryllium Cadmium Chromium Copper Nickel Silver Thallium Zinc Arsenic Lead Selenium Mercury	HNO_3 to pH<2	P or G	1 Liter	6 months 28 days
Cyanide	NAOH to pH>12 Cool, 4°C Add 0.6g ascorbic acid if residual chlorine present	P or G	1 Liter	14 days
Priority Pollutant Base Neutral/Acids (no TICs)	Cool, 4°C	G Teflon-lined cap	80 Ounce	Extraction - within 5 days; Analysis - within 40 days after extraction
PCBs/Pesticides, TCL	Cool, 4°C	G Teflon-lined cap	80 Ounce	Extraction - within 5 days; Analysis - within 40 days after extraction
Bromide	Cool, 4°C	P or G	1 Liter	28 days
Chloride	Cool, 4°C	P or G	1 Liter	28 days
Fluoride	Cool, 4°C	P	1 Liter	28 days
Nitrate	Cool, 4°C	P or G	1 Liter	48 hours
Phosphate	Cool, 4°C	P or G	1 Liter	28 days
Sulfate	Cool, 4°C	P or G	1 Liter	28 days
Total Dissolved Solids	Cool, 4°C	P or G	1 Liter	7 days
Gross Alpha, Gross Beta	HNO_3 to pH <2	G	1 Liter	6 months
Radium-228*	HNO_3 to pH <2	G	1 Liter	6 months
Radium-226*	HNO_3 to pH <2	G	1 Liter	6 months
Gamma Spectrometry	HNO_3 to pH <2	G	1 Liter	6 months

TABLE B-9
METHODS OF PRESERVATION, SAMPLE CONTAINERS, AND HOLDING TIMES
SHEPPARD AIR FORCE BASE, WICHITA COUNTY, TEXAS
PAGE TWO

MATRIX: SOIL

Parameter	Preservation	Sample Container	Sample Container Size	Holding Time
Volatile Organics, TCL (no TICs)	Cool, 4°C	G Teflon-lined septum	2-4 Ounce	10 days
Antimony Beryllium Cadmium Chromium Copper Nickel Silver Thallium Zinc Arsenic Lead Selenium Mercury	Cool, 4°C	P or G	8 Ounce	6 months 6 months 6 months 6 months 6 months 6 months 6 months 6 months 6 months 6 months 6 months 6 months 28 days
Priority Pollutant Base Neutral/Acids (no TICs)	Cool, 4°C	G Teflon-lined cap	2-8 Ounce	Extraction - within 10 days; Analysis - within 40 days after extraction
Organophosphorus Pesticides	Cool, 4°C	G Teflon-lined cap	8 Ounce	Extraction - within 7 days; Analysis - within 30 days after extraction
PCBs/Pesticides, TCL	Cool, 4°C	G Teflon-lined cap	8 Ounce	Extraction - within 10 days; Analysis - within 30 days after extraction
Chlorinated Herbicides	Cool, 4°C	G Teflon-lined cap	8 Ounce	Extraction - within 10 days; Analysis - within 30 days after extraction
Cation Exchange Capacity	Cool, 4°C	G	4 Ounce	Unspecified
Gamma Spectrometry		G	4 Ounce	6 months

* Analysis for the isotope of radium will be performed only if gross alpha and/or gross beta exceed background levels.

P = Polyethylene
G = Glass

References:
"Test Methods; Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA Document 600/4-82-057, Environmental Monitoring and Support Branch, Cincinnati, Ohio, 1982.
"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Document SW846, Third Edition, Revised USEPA 1986.
"Methods of Soil Analysis, Part II, Chemical and Microbiological Properties," Second Edition, 1982.

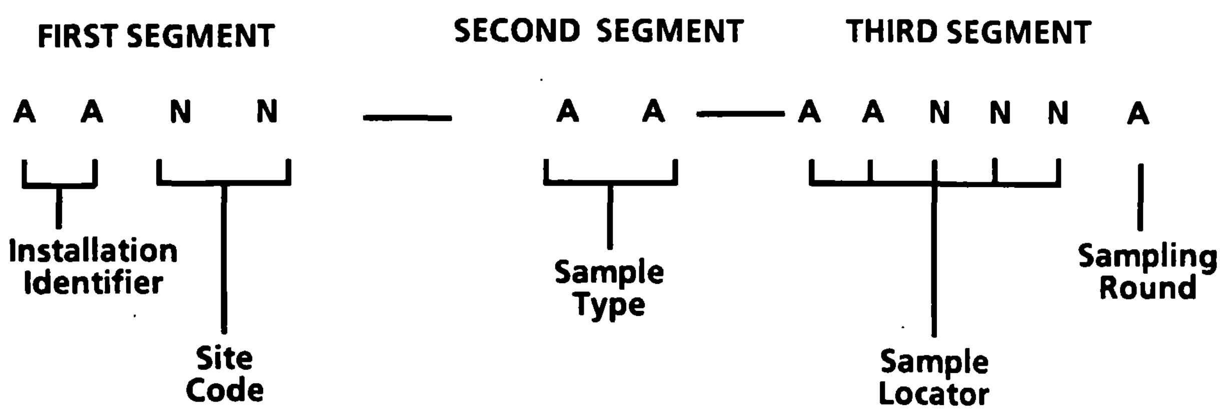
held until a determination can be made as to whether or not a potential equipment-cleaning problem exists. Rinsate blanks will be analyzed for all applicable organics and metals.

- Field Blanks - Field blanks will be used to check for cross-contamination resulting from water used for decontamination. Each bottle will be filled with deionized water on site by the sampler and shipped to a laboratory for analysis. One set of field blanks will be prepared for each source of decontamination water used per sampling trip. Field blanks will be analyzed for all applicable organics and metals.

B.3.4 Sample Numbering System

Each sample collected will be assigned a unique sample number. The sample number will consist of a three-segment alphanumeric code which identifies the installation, the site, the sample type, the sample collection location, and the sampling round.

The alphanumeric coding to be employed in the sample numbering system is explained in the following diagram and the subsequent definitions:



Character Type:

A = Alpha
N = Numeric

Installation Identifier:

SH = Sheppard Air Force Base

Site Code: See Table B-10

Sample Type: These include, but are not limited to, the following:

SW = Surface Water
GW = Ground Water
SS = Surface Soil
SU = Subsurface Soil
SE = Sediment
FB = Field Blank
TB = Trip Blank
RB = Rinsate Blank

Sample Locator:

Sample locators will indicate precisely where each sample was collected (e.g., MW-101 would indicate that the sample was collected from monitoring well number 101).

Sampling Round:

Sampling events (or rounds) will be in alphabetical sequence beginning with "A."

TABLE B-10

SAMPLE NUMBERING SYSTEM SITE CODES
SHEPPARD AIR FORCE BASE
WICHITA COUNTY, TEXAS

Site Description	Acronyms	Site Code
Waste Pit - 1	WP-1	01
Landfill - 1	LF-1	02
Landfill - 2	LF-2	03
Landfill - 3	LF-3	04
Fire Protection Training Area - 1	FPTA-1	05
Fire Protection Training Area - 2	FPTA-2	06
Fire Protection Training Area - 3	FPTA-3	07
Industrial Waste Pit	WP-2	08
Pesticide Spray Area	PSA	09
Low-Level Radioactive Waste Disposal Site - 1	LLRW-1	10
Low-Level Radioactive Waste Disposal Site - 2	LLRW-2	11

C

APPENDIX C

TECHNICAL SPECIFICATION
FOR
SURVEYING SERVICES

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)

ELEVEN SITES AT SHEPPARD AFB
WICHITA FALLS, TEXAS

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C.1.0 GENERAL

This specification defines the technical requirements and quality of workmanship required for surveying services at Sheppard Air Force Base (AFB) Wichita Falls, Texas.

C.2.0 ABBREVIATIONS

The abbreviations listed below, where used in this specification, shall have the following meaning:

AFB	Air Force Base
NOAA	National Oceanic and Atmospheric Administration
NUS	NUS Corporation

C.3.0 QUALITY STANDARDS

The Subcontractor shall control the quality of items and services to meet the requirements of this specification, applicable codes and standards, and other Subcontract documents.

Unless otherwise specified or shown, the following codes and standards of the latest issue at time of subcontract award shall apply to the extent indicated herein:

Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys, published by the U.S. Department of Commerce, NOAA.

C.4.0 MATERIALS

C.4.1 Reference Hubs

Reference hubs shall be a minimum size of 2 by 2 by 8 inches, shall be made from solid milled lumber, and shall be pointed on the end. The survey point shall be indicated with a survey tack driven into the top of the hub. Hubs shall be driven flush with the ground surface. When the nature of the ground is such that wooden hubs cannot be used, stout spikes may be substituted; the survey point shall be indicated by a punchmark at least 1/16-inch deep on the top of the spike.

C.4.2 Guard Stakes

Stakes shall be 1 by 2 inches, at least 3 feet long, milled from solid lumber, and shall be pointed on the end. Rebar, number 5 or larger, shall be substituted for wooden stakes where wooden stakes cannot be driven. Stakes, both wooden and rebar, shall be clearly marked with bright orange weatherproof flagging and paint. Rebar shall also be capped with plastic rebar caps.

C.4.3 Miscellaneous

Miscellaneous material (e.g., tacks, P-K nails, flagging, etc.) shall be of the type and quality normally used for land survey work.

C.5.0 FIELD OPERATIONS

C.5.1 General

- The Subcontractor shall maintain sufficient equipment, materials, parts, tools, and supplies to meet the requirements of the work. Surveying equipment shall be subject to inspection by NUS at all times, and if deemed unsatisfactory, shall be removed from the site and replaced by satisfactory equipment. Surveying equipment shall have been inspected and calibrated by an authorized manufacturer's representative not less than 6 months prior to the survey. The Subcontractor shall submit a certificate of compliance for instrument calibration with his bid package.

- All work shall be performed under the supervision of a Land Surveyor registered in the State of Texas. Survey crew personnel shall be competent and experienced in performing land survey work.

- The necessary field data shall be recorded by the surveyor in a standard field book, using generally-accepted surveying field-note recording practices.

- The Subcontractor shall be available to provide surveying services within 48 hours of notification from NUS to provide said services.

C.5.2 Ground Survey

- Subcontractor shall furnish and install two semi-permanent survey monuments at all eleven sites. These monuments shall be established in accordance with the existing Sheppard AFB Coordinate System and shall be tied to the North-Central Texas State Plane Coordinate System (NCTSPCS).

- Horizontal accuracy for the establishment of semi-permanent survey monuments shall be Second-Order Class II accuracy, and vertical accuracy shall be Second-Order Class II accuracy as defined by Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.

- The semi-permanent survey monuments shall be constructed of No. 4 rebar, 24 inches in length, driven 18 inches into the ground. The point of measurement shall be permanently marked on the top of the rebar.

- Semi-permanent survey monuments shall be clearly tagged with the monument name, Sheppard AFB coordinates, and elevation above mean sea level. The Subcontractor shall furnish and install monument guard stakes at each survey monument installed.

- The Subcontractor shall perform a closure survey to verify the as-built location, Sheppard AFB coordinates, and elevation of each semi-permanent monument installed, and to verify that the order of accuracy complies with this specification.

- The Subcontractor shall perform a ground survey of all monitoring wells, boreholes, and sample locations. The survey shall be in accordance with the existing coordinates.

- The Subcontractor shall determine centerline Sheppard AFB coordinates, geodetic (latitude and longitude) coordinates, top-of-casing elevation, and ground elevation of each monitoring well. The Subcontractor shall permanently mark the well casing at the point where the elevation is established.

- Horizontal accuracy for locations of monitoring well casing centerlines shall be Third-Order Class II accuracy, and vertical accuracy for top of well casings shall be Third-Order accuracy as defined by Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. The vertical accuracy for ground elevations at each monitoring well or borehole shall be within 0.01 feet.

- The Subcontractor shall provide, on a metal tag permanently attached to the underneath side of the 6-inch monitoring well casing cap (or the lid of the christy box, as applicable), the following information: well identification, Sheppard AFB coordinates, and top of casing elevation.

C.5.3 Geophysical Grid Survey

- The geophysical grid coordinate system to be established at the four landfill sites shall be tied to the existing Sheppard AFB Coordinate System.

- The Subcontractor shall establish reference baselines and hubs at each landfill.

- Horizontal accuracy for reference baselines and hubs shall be Third-Order Class II accuracy, and vertical accuracy for reference baselines shall be Third-Order accuracy as defined by Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.

- A guard stake shall be securely placed within 6 inches of each reference hub where possible. Grid coordinates and the elevation of each reference hub shall be clearly and permanently provided on each guard stake. Alternatively, if a guard stake is not placed next to a reference hub, the hub shall be indicated with bright orange paint, and the geophysical grid coordinates and elevation clearly and permanently provided on a tag securely fastened to the hub.

- The Subcontractor shall establish the geophysical grid system using 50-foot grid intervals with mutually perpendicular grid lines. Wooden marker stakes shall be placed at each 50-foot interval. Where the line of sight is obstructed between adjacent markers because of vegetation, the line of sight shall be cleared as required. Where the line of sight is obstructed by physical barriers, additional markers shall be placed on the grid lines at less than 50-foot intervals; these shall be placed to allow the geophysical survey team members to visually align themselves in each direction on the grid lines. No marker will be required if the intersection point is covered by water; however, a marker shall be provided on the grid line near the edge of the water.

  Horizontal accuracy for geophysical grid survey tracks and intersection points (wooden markers) shall be within 1 foot. Elevations of the grid system intersection points along the survey tracks will not be determined.

- Grid markers shall be firmly secured into the ground and shall extend a minimum of 1 foot above ground surface. Where the intersection of grid lines is such that a rebar or wooden stake cannot be used (e.g., concrete, pavement, rock, etc.), the point shall be clearly indicated with bright orange paint and a P-K nail where possible. The location designation of each grid marker shall be clearly written on each wooden stake with indelible ink, or the location shall be written on a weather-proof tag and attached to each marker.

C.6.0 OFFICE WORK

C.6.1 General

- As specified herein, and as directed by NUS, the Subcontractor shall prepare drawings detailing information obtained during surveys. Such work shall be performed by experienced drafters in facilities provided by the Subcontractor.

- All submitted drawings and reports, and all information transposed to drawings furnished by NUS, shall be reviewed and certified correct by a Land Surveyor registered in the State of Texas.

- All drawings prepared by the Subcontractor for NUS shall be submitted on 34-inch by 24-inch reproducible plastic film or mylar. All lines shall be drawn with waterproof, durable ink that will not chip or flake with reasonable use.

- The Subcontractor shall prepare, in tabular form, a schedule for:

  - monitoring wells
  - all environmental samples
  - reference hubs

  The schedule shall contain the item delimiter (monitoring well, surface soil, etc.), Sheppard AFB coordinates, and elevation.

C.6.2 Geophysical Grid Site Plan

A reproducible drawing of the geophysical grid plan at the landfill sites will be provided by the Subcontractor to NUS. The Subcontractor shall transpose to the drawing the information obtained from the geophysical grid reference baselines and hubs; this shall include at least the following:

- A schedule of the ground surface elevation at each reference hub.

- The location by geodetic and Sheppard AFB coordinates of each reference hub.

- Tie-in to the nearest State Coordinate System point by bearing and distance.

- Declination from true north and magnetic north.

C.6.3 Note Reduction and Calculations

The Subcontractor shall reduce field notes and perform related calculations. All calculations shall be reviewed and certified for correctness by a Land Surveyor registered in the State of Texas. Field books shall become the property of NUS at the close of the work.

D

APPENDIX D

TECHNICAL SPECIFICATION
FOR
DRILLING ACTIVITIES

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)

ELEVEN SITES AT SHEPPARD AFB
WICHITA FALLS, TEXAS

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FIGURES

D.1.0 GENERAL

The work specified herein shall be performed at Sheppard Air Force Base (AFB), Wichita Falls, Texas.

D.2.0 ABBREVIATIONS

The abbreviations listed below, where used in this specification, shall have the following meanings:

ASTM	American Society of for Testing and Materials
NUS	NUS Corporation

D.3.0 QUALITY STANDARDS

The codes and standards specified herein shall apply to all material, equipment, samples, and field operations performed under this technical specification. The latest edition, at the time of request for bid, shall apply for all codes and standards.

ASTM D-653	Terms and Symbols Relating to Soil and Rock
ASTM D-1586	Method for Penetration Test and Split-Barrel Sampling of Soils
ASTM C-150	Specification for Portland Cement

D.4.0 MATERIALS

D.4.1 Cement

All cement shall conform to ASTM C-150, Type II Portland cement.

D.4.2 Bentonite

The bentonite shall be a free-flowing, high-swelling, sodium-based, Wyoming-type bentonite and shall be supplied in both powdered and pellet form.

D.4.3 Cement/Bentonite Grout

Grout shall consist of materials specified herein and shall be mixed approximately in the following proportions: 7.5 gallons of water and 2.5 pounds of powdered bentonite per sack of Type II Portland cement.

D.4.4 Filter Pack

Filter pack material shall have 100 percent by weight passing a No. 4 U.S. standard sieve and no more than 5 percent by weight passing a No. 50 U.S. standard sieve. Sand shall be clean and have a uniformity coefficient of 1.75 or less. A sieve analysis shall be submitted to NUS for approval prior to use. Sand size specifications are subject to change at the discretion of NUS, based on field conditions.

D.4.5 Water Supply

All water used for drilling, cleaning drilling equipment, or mixing grout shall be clean potable water obtained from a source approved by NUS.

D.4.6 Polyethylene Sheeting

Polyethylene sheeting for ground cover, temporary storage of down-hole tools and equipment, and wrapping down-hole tools, bits, and rods shall be 8-mil polyethylene film or other material approved by NUS. A sample of the polyethylene sheeting shall be submitted to NUS prior to use.

D.4.7 Thread Lubricant

All thread lubricant used for connection of drill rods shall be vegetable oil (Crisco) or an approved equal reviewed by NUS prior to use. The brand name, manufacturer, and a sample of the lubricant shall be submitted to NUS when requested.

D.4.8 Monitoring-Well Casing

Monitoring-well casing shall be threaded, flush-joint, 2-inch, nominal pipe size, Schedule 40 PVC pipe. Monitoring-well casing shall be supplied in 20-, 10-, and 5-foot lengths with flush-joint threaded ends and shall include fittings and plugs. A threaded, vented cap shall be provided for each well. A catalog cut of the monitoring-well casing shall be submitted to NUS for approval prior to purchase.

D.4.9 Christy Boxes

Christy boxes shall be 12" diameter, manhole designed, and constructed of cast iron on plastic caps and body rings with 12" long steel skirts. The cap shall be constructed so that it can be removed easily without tools. The manufacturer and model number of the christy box shall be submitted to NUS upon request.

D.4.10 Monitoring-Well Screen

Monitoring-well screens shall be 2-inch nominal pipe size, Schedule 40 PVC screen with slot size of 0.010 inch. The monitoring-well screens shall be threaded flush-joint type screens. Monitoring-well screens shall be supplied in 5-foot lengths. A catalog cut of the monitoring-well screen shall be submitted to NUS for approval prior to purchase.

D.5.0 EQUIPMENT

- Drilling equipment shall be mobile rigs with auger capabilities. The rigs shall be capable of advancing 6- to 10¼-inch outside diameter continuous-flight, hollow-stem augers to a depth of 50 feet. If any boring cannot be advanced by this method, other drilling methods approved by NUS, such as air rotary, shall be used.

- Drilling equipment shall be in good mechanical condition and free from obvious leaks in hydraulic lines, couplings, and fittings to prevent contamination of the boring. The Subcontractor shall maintain sufficient equipment, spare parts, materials, parts, tools, and supplies to meet the requirements for the work. Supplies for drilling shall, at a minimum, include all auger flights, bits, pipes, pumps, tools, drill rods, temporary casing, and any other materials required to complete the specified work. Split-spoon samplers shall measure 2 inches in outside diameter and be 18 inches long.

- The steam cleaner-pressure washer unit shall be a Model S-1000-C-OEP as manufactured by the Jenny Division, Homestead Industries, Inc., or equal, submitted to NUS for review. The combination unit shall provide: steam at 2.2 GPM and 450 PSI; hot water pressure wash at 4 GPM, 1800 PSI, and 200°F; or cold water pressure wash at 4 GPM and 1800 PSI. The unit shall be provided with 100 feet of 1/2-inch, wire-reinforced, vapor hose in 50-foot increments; a spray lance with on/off control over the flushing; and various nozzles with quick disconnects for fast and efficient use of the machine. The Subcontractor shall submit to NUS a catalog cut of the decontamination unit with his bid.

D.6.0 FIELD ACTIVITIES

D.6.1 General

- Monitoring wells may be added, deleted, or relocated as directed by NUS.

- The maximum depth of any hole measured parallel to the drill axis will not exceed 50 feet.

- The sequence of borings and samples will be determined by NUS.

- The final number, locations, and depths of the monitoring-well holes will be determined in the field by NUS.

- All holes shall be drilled straight, plumb, and free of any obstructions to permit free and easy installation of the monitoring-well casing. Faulty alignment of the holes shall be corrected by the Subcontractor at no additional cost to NUS, in the manner designated by NUS.

- Final surveying of the well locations after monitoring-well installation is complete will be provided by NUS.

- If thread lubricant is used by the Subcontractor in the connection of drill rods, care shall be taken such that only the minimum amount necessary is applied to the joints.

D.6.2 Cleaning of Monitoring-Well Casing, Well Screens, Equipment, and Tools

- All monitoring-well casings, screens, drill rigs, tools, equipment, drill rods, bits, and augers shall be pressure-washed with high-pressure hot water prior to use. The steam cleaning equipment is specified in Section D.5.0 of this technical specification.

- Cleaned monitoring-well casings and screens shall be stored with a protective covering around them to prevent them from coming into contact with the ground and airborne contaminants.

- After completion of drilling and well installation, the drill rig(s), augers, bits, drill rods, and down-hole tools and equipment shall be moved away from the well, but left in close proximity for cleaning.

- After positioning the drill rig(s) and/or the other equipment/tools in the cleaning area, external surfaces of the equipment shall be washed with the high-pressure wash unit as required to remove all adhering material.

- NUS may require, on a site-specific basis, that the drill rig and all equipment, tools, etc. be moved to a decontamination area for cleaning between drilling sites.

- Following release by NUS, the drill rig(s) and/or other equipment/tools shall leave the cleaning area and proceed to the next monitoring-well location.

- Solid materials remaining in the cleaning area shall be leveled, raked, seeded, and mulched at the site. However, NUS may require that the solid materials remaining at the decontamination area be salvaged for alternate disposal at Sheppard AFB.

- The Subcontractor shall operate, maintain, and provide fuel for the high-pressure spray unit as required. No electrical power will be available for the high-pressure spray unit.

- The Subcontractor shall provide all disposable items needed to operate the cleaning facility for the duration of the project.

D.6.3 Drilling Operations

- Drilling in soils and other unconsolidated materials shall be performed using the hollow-stem auger or air rotary method which will provide a minimum nominal hole diameter of 6 inches.

- Before drilling starts at each boring, a polyethylene ground cover shall be placed around the area to be drilled. The ground cover shall be large enough to contain all the cuttings from the boring.

- Borings which cannot be drilled to the required depth, as determined by NUS, shall be abandoned. Abandoned holes shall be backfilled with cement grout as specified herein, and supplemented by another boring adjacent to the first.

- Where necessary to keep the boring open and to complete monitoring-well installation, a temporary casing may be used. After the permanent monitoring-well casing has been set, the temporary drill casing shall be removed and cleaned prior to its reuse.

- Drilling fluid additives or water shall not be used for drilling without written authorization from NUS.

- All cuttings shall be stored at the drilling site on the polyethylene ground cover. NUS shall inspect the cuttings and collect a composite sample of the cuttings for head space analysis using an organic vapor analyzer. If the cuttings are clean and NUS so directs, the Subcontractor shall reclaim the cuttings on site by leveling, raking, seeding, and mulching the disturbed area. If the cuttings are contaminated and NUS so directs, the Subcontractor shall salvage the cuttings for alternate disposal at Sheppard AFB. Alternate disposal may consist of transport to a designated treatment or disposal area located at Sheppard AFB, or burial at the site.

D.6.4 Soil Sampling

- When collecting samples for chemical analysis, all sampling equipment shall be decontaminated prior to each use as follows:

  - Wash with Alconox detergent and potable water
  - Rinse with potable water
  - Rinse with deionized water
  - Air dry
  - Wrapped in aluminum foil until used

- Care shall be taken to ensure that sampling equipment is protected from ground contact. A ground cover shall be used for temporary storage of equipment in the work area.

- Prior to sampling, all loose and disturbed materials shall be removed from the boring in a manner that minimizes disturbance of the material to be sampled. When temporary drill casing is used, sampling shall be accomplished in advance of the casing at all times. In saturated soils, drill rods shall be withdrawn slowly to prevent sloughing in the hole.

- Samples shall be protected from exposure to extreme hot and cold temperatures at all times.

- Split spoon samples shall be taken for geological interpretation at 5-foot intervals with a split barrel sampler as described in ASTM D-1586. The sampler shall be driven into the soil a maximum of 18 inches or to refusal. (Refusal is defined as 6-inch penetration or less per 50 blows.) Drive shoes shall be replaced or repaired when they become dented or distorted.

D.6.5 Backfilling Abandoned Monitoring-Well Holes

When backfilling abandoned borings or installing cement grout around monitoring wells, grout shall be tremied into the well or hole. The tremie pipe shall be lowered to the bottom of the hole, and raised slowly as the grout is slowly introduced. The tremie pipe shall be kept full continuously from start to finish of the grouting procedure, with the discharge end of the tremie pipe being continuously submerged in the grout until the hole is completely filled. Should loss of grout occur, holes shall be refilled until they remain full.

D.6.6 Ground-Water Observations

Observations shall be made of ground-water levels in all uncompleted drill holes prior to the resumption of drilling on each day. Any and all water conditions, including the presence of artesian flows, shall be recorded by the Subcontractor at the depth encountered. Whenever required by NUS, holes shall be bailed by the subcontractor for observation of ground-water conditions.

D.6.7 Driller Logs

The Subcontractor shall keep and, at the completion of each drill hole, furnish to NUS, an accurate driller's log of that hole. The logs shall show depth at which each change in material or stratification occurs; depth at which samples were obtained and the type of sample in each instance; depth of gain or loss of drilling fluids; depth to ground water or artesian flows; standard penetration resistance; depth to water table at the beginning and end of each shift; and other data as requested by NUS. The Subcontractor shall furnish all necessary assistance and cooperation to NUS with regard to recordkeeping.

D.6.8 Monitoring-Well Installation

- Monitoring wells shall be installed in accordance with the monitoring-well details shown in Figures D-1 and D-2.

- The sump section of the casing shall rest on the bottom of the hole with the screen located at the required depth. The sump shall have a bottom cap.

- The sand for the filter pack shall be poured into the annular space between the riser pipe and hollow-stem auger opening. The filter pack shall extend at least 1 foot above the top of the screen.

- After the filter pack is placed, bentonite pellets shall be inserted into the annulus. After sufficient time has elapsed for the pellets to reach the filter pack, they shall be tamped in place using a rod, pipe, or heavy weight attached to a rope. The rope shall be replaced with new rope after the bentonite seal is installed. The minimum thickness of this bentonite seal, after tamping, shall be 3 feet above the filter pack.

- After the grout has set, each monitoring well shall be developed by bailing, pumping, or surging. The Subcontractor shall develop the monitoring wells as specified herein.

- Upon completion, each monitoring well shall be tested under the direction of NUS to confirm that the monitoring well is operative. If, as a result of improper installation, a monitoring well is considered inoperative or unsatisfactory by NUS, the Subcontractor shall modify the monitoring well or replace the monitoring well at no additional cost to NUS.

D.6.9 Well Development

Monitoring wells shall be developed to remove clay, silt, auger cuttings, and other fines from the monitoring well. The monitoring well is properly developed when the water is not turbid or is free from suspended matter. The

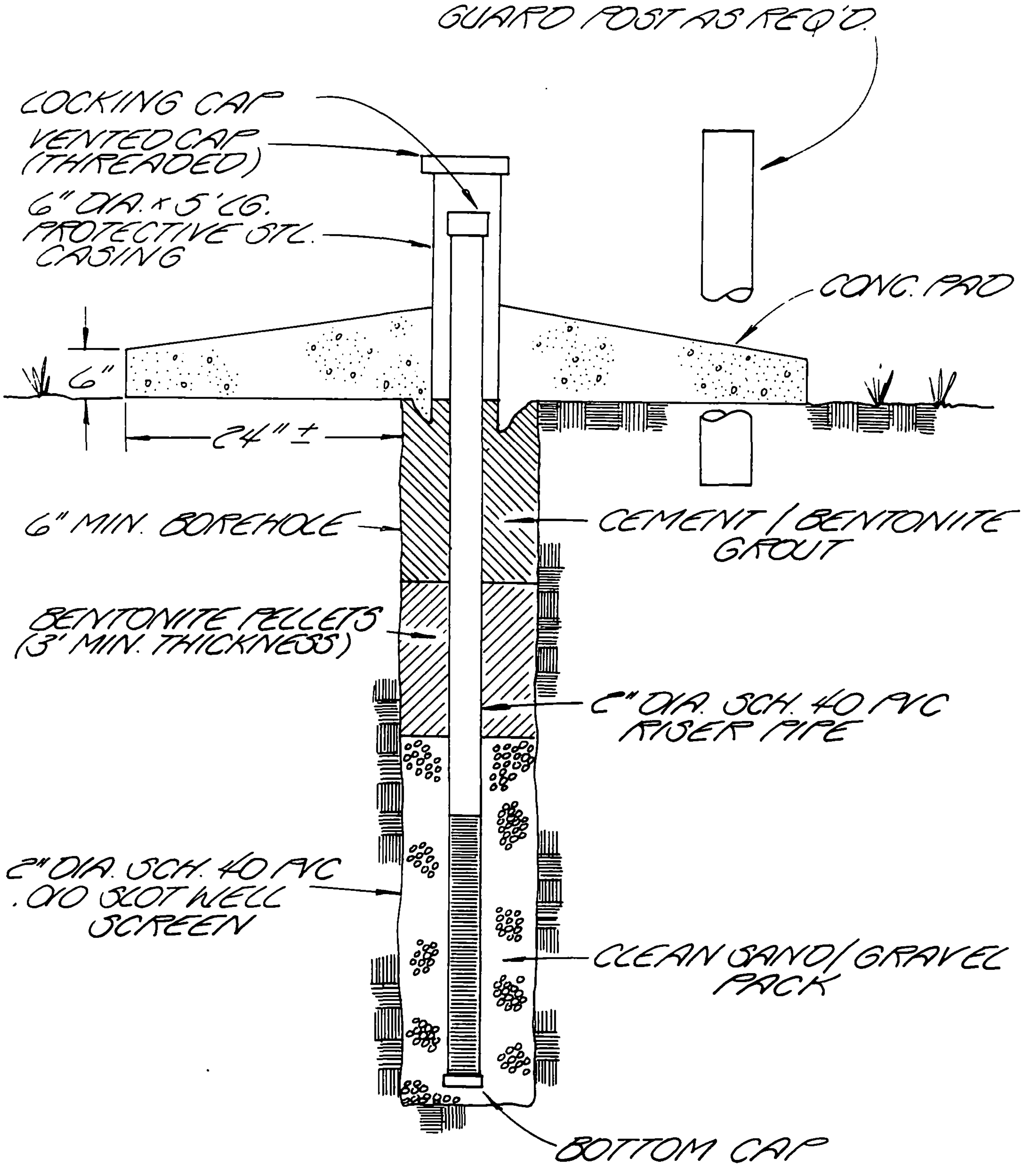

FIGURE D-1 TYPICAL MONITORING-WELL CONSTRUCTION

SHEPPARD AIR FORCE BASE

NUS CORPORATION

BRUNING 44-232 74139

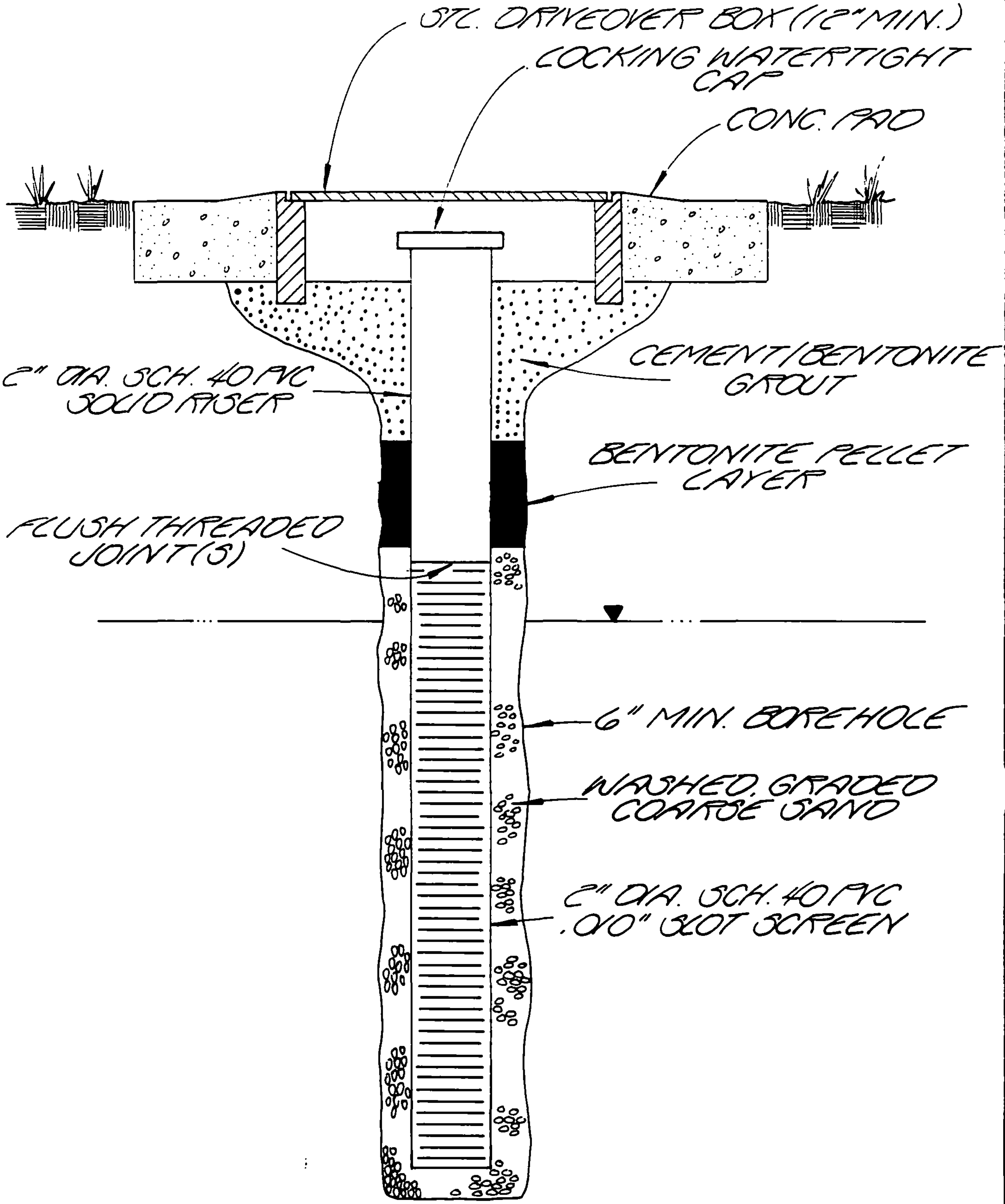

FIGURE D-2 TYPICAL AT-GRADE MONITORING-WELL CONSTRUCTION

SHEPPARD AFB

NUS CORPORATION

BRUNING 44-232 74139

preferred development method will be by surge block, followed by bailing. Other methods, such as pumping, may be used upon approval by NUS. No extracted ground water shall be discharged to any drainage ditch, storm sewer, or surface water. NUS shall determine when a monitoring well is properly developed.

D.6.10 Cleanup

The work areas shall be kept in neat and orderly condition at all times. Upon completion of the work, the Subcontractor shall remove its rigs and all surplus and unused material and shall leave the area in a clean condition, all to the satisfaction of NUS. Except for monitoring wells or as directed by NUS, the Subcontractor shall remove all well casings, and all holes shall be completely backfilled as specified herein. All areas disturbed by the drilling operations shall be restored to their condition prior to drilling. Any ruts left by the drilling operations shall be filled in, leveled, and reseeded as specified by NUS. If directed by NUS, cuttings and other soil materials left on site by the drilling, cleaning, and well installation activities shall be leveled, raked, seeded, fertilized, and mulched to provide a stable ground cover consistent with the existing land use.

E

APPENDIX E
DATA VALIDATION GUIDELINES

REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM (IRP)

ELEVEN SITES AT SHEPPARD AFB
WICHITA COUNTY, TEXAS

TABLE OF CONTENTS

E.1.0 ORGANICS

Listed below are the validation criteria which will be utilized in evaluating the analytical data developed for the nine sites at Shepard AFB.

E.1.1 PETROLEUM HYDROCARBONS (EPA 418.1, SW3540, EPA METHOD 418.1)*

HOLDING TIMES

Holding times are undefined if the samples are preserved and refrigerated.

CALIBRATION

Make certain that a five-point curve is completed daily.

BLANKS

Make certain that a blank is run daily.

E.1.2 TCL VOAs EPA-CLP METHODOLOGIES

Validation procedures will be in accordance with: "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," May 1985 (except qualitative and semi-quantitative analyses for TICs).

E.1.3 PRIORITY POLLUTANT BNAs EPA-CLP METHODOLOGIES

Validation procedures will be in accordance with: "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," May 1985 (except qualitative and semi-quantitative analyses for TICs).

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* EPA 100, 200, 300, and 400 series refer to Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March, 1983.
"SW" refers to Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, Third Edition, November, 1986.
EPA 600 series refers to Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, July, 1982.

E.1.4 TCL PESTICIDES/PCBs, ORGANOPHOSPHORUS PESTICIDES AND CHLORINATED HERBICIDES – EPA-CLP METHODOLOGIES

Validation procedures will be in accordance with: "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," May 1985.

E.2.0 INORGANICS

E.2.1 PRIORITY POLLUTANT METALS (EPA-CLP METHODOLOGIES)

Validation procedures will be in accordance with: "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," May 1985.

E.2.2 COMMON ANIONS

Anion	Method Reference
Cyanide (CN^-)	EPA 335.2
Sulfate ($SO_4^=$)	SM426C
Phosphate (PO_4^{-3})	EPA 365.2
Nitrate (NO_3^-)	EPA 352.1
Fluoride (F^-)	SM* 413 B
Chloride (Cl^-)	SM 407 B
Bromide (Br^-)	EPA 320.1

E.2.2.1 CYANIDE, SULFATE, PHOSPHATE

<u>HOLDING TIMES</u>

Cyanide	-	14 days
Sulfate	-	Unspecified
Phosphate	-	None, if preserved

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* SM refers to Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 16th Edition, 1985.

If the above holding times are not met, all corresponding data will be considered estimates (J).

CALIBRATION

Check to verify if a daily standard was run and compared to a previous calibration curve. This must meet internal QC criteria.

DUPLICATES AND MATRIX SPIKE

Duplicates and a matrix spike must be analyzed 1 in 20 per matrix per Air Force Base.

The resulting data should meet internal QC criteria.

E.2.2.2 NITRATE

HOLDING TIME

The holding time for nitrate is 14 days. If this is not met, all corresponding data will be considered estimates (J).

CALIBRATION

A five-point calibration curve should be prepared each day sample analyses are performed.

DUPLICATES AND MATRIX SPIKE

Duplicates and a matrix spike must be analyzed 1 in 20 per matrix per Air Force Base.

E.2.2.3 FLUORIDE (SOLUBLE)

HOLDING TIME

No holding time is indicated in the method.

CALIBRATION

A three-point calibration curve should be prepared each day sample analyses are performed.

DUPLICATES AND MATRIX SPIKE

Duplicates and a matrix spike must be analyzed 1 in 20 per matrix per Air Force Base.

E.2.2.4 CHLORIDE

HOLDING TIME

No holding time is indicated in the method.

CALIBRATION

Standardization of the titrant must be done monthly.

DUPLICATES AND MATRIX SPIKE

Duplicates and a matrix spike must be analyzed 1 in 20 per matrix per Air Force Base.

E.2.2.5 BROMIDE

HOLDING TIMES

Samples must be analyzed as soon as possible.

CALIBRATION

Standardization of the sodium thiosulfate titrant must be done daily.

DUPLICATES AND MATRIX SPIKE

Duplicates and a matrix spike must be analyzed 1 in 20 per matrix per Air Force Base.

E.2.3 TOTAL DISSOLVED SOLIDS

HOLDING TIME

The holding time for total dissolved solids is 7 days. If this is not met, all corresponding data will be considered estimates (J).

DUPLICATES

Duplicates must be analyzed in 20 per matrix per Air Force Base.

E.2.4 CATION EXCHANGE CAPACITY

HOLDING TIMES

Samples must be analyzed as soon as possible.

CALIBRATION

Standard of known cation exchange capacity must meet internal QC limits.

BLANKS

Verify that contamination and memory effects are not occurring.

E.2.5 RADIOLOGICALS

DUPLICATES

Duplicate must be analyzed 1 per sample batch.

BLANKS

Verify that contamination and memory effects are not occurring.

SPIKE SAMPLE OR STANDARD REFERENCE CHECK

Ensure equipment is calibrated and operating properly.